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A suit against a telephone company, because the instrument failed to work when used to call the fire department, has been brought in New York state. This is believed to be the first suit of the kind on record and the decision will be watched with much interest. The claim is made that damage was done by the fire which, had the telephone been properly connected and in working order, would have been prevented. The suit would seem to turn on the interpretation of the contract under which the instrument was installed. The question is, however, of general interest; because the liability of telephone companies for defects in wires or instruments—causing "misconnections," in the language of the complaint—is a new one in the courts.

MEETING OF THE ELECTROCHEMICAL SOCIETY.

The fourth general meeting of the American Electrochemical Society is being held at Niagara Falls this week. This society is forging ahead rapidly and the meeting promises to be as successful as those already held. A good programme was prepared and at this writing a good attendance is indicated.

FIREPROOF CARS.

Why has there not been an effective effort to introduce all-metal passenger cars for railway purposes? The all-steel freight car has met with deserved success and the railroads can not secure them fast enough, yet the step from the construction of an all-steel freight car to the construction of an all-steel passenger car is not an insurmountable one, and we have been informed that one of the western steam roads has a steel car in service. The advantages of steel for this purpose are evident—it is light, strong and, above all, incombustible. Let us hope that the day when all passenger cars will be built without the use of wood may not be long delayed.

ELECTRICAL INSTRUMENTS.

It is not difficult to find many good reasons for the rapid development and application of electricity in its various forms to its manifold uses. One reason is undoubtedly the ease with which electrical energy may be accurately measured.

Electrical energy, from its very nature, can not be measured as water or gas, but must be estimated by certain effects which it produces, and this measurement can be made without interfering to any practical degree with the normal flow of the current. Thus, the engineer of a generating station is able at any instant to see not only what has been the total production of electrical energy for the day, but at what rate and in what form it is at that moment being produced by the station as a whole by the several generating units, and at what rate it is being delivered to each of the sections supplied.

The importance and convenience of this is very great, and therefore the manufacture of electrical instruments of all kinds has become a most important industry. These instruments may depend for their action upon one of several effects produced by the passage of the current. They may be of all grades, from the cheapest indicator which gives only a rough idea of what is going on to the type of instrument used in scientific research, which may have an accuracy and sensibility far exceeding that of any other type of physical measuring instrument. The manufacture of these instruments has called for the design of entirely new machinery and a special training of a high order. It is a fact—although it is not generally known—that the work done on certain classes of electrical instruments is as delicate and accurate as that done in the best watch manufactories of the world.

ELECTRICITY USED TO OPERATE PUMPING STATIONS FOR DRAINAGE AND SEWERAGE PURPOSES IN THE SOUTHERN STATES.

In 1897 the New Orleans Drainage Commission called for bids on a large portion of the drainage system to be constructed in that city. Bidders were requested to submit figures on either a number of separately operated steam pumping stations or the same number of electrically operated pumping stations, and a power-house to furnish the necessary current. The two methods of operation were thus placed in competition. After canvass of the bids the commission let the contract for an electrically operated system, using current at 3,150 volts on the line and synchronous electric motors taking current direct from the line to operate the various pumps. Subsequent to 1897 additional contracts were let for the installation of additional pumping machinery, additional power generating machinery and two additional pumping stations which have recently been completed. Both of these last stations are now under test. There are now five electrically operated pumping stations with a partial equipment, and there will ultimately be two more pumping stations. Unfortunately this particular system is not now being increased to the capacity originally contemplated.

Superiority of the Electrically Driven Equipment.

The electrical features of this system have proven entirely successful. The only difficulty that has arisen has been in securing a reasonably high efficiency of the pumping machinery when operated at other heads than those for which the individual pumps are especially designed. The synchronous motors are subject to speed control only by controlling the speed of the generators, and as all of the various pumping stations are designed to operate independently off of any generating unit at central station or off of all the generating units in multiple, it is not usually practicable to vary the speed. The system is also operating at a very great disadvantage owing to the utter inadequacy of the present equipment as regards capacity, not through any fault of the machinery, but owing to its being only a partial equipment. Even taking these things into consideration, however, the expense of operation and the convenience of the electrical system make it unquestionably superior to the system of independent steam-driven stations.

Electrically Operated Sewage Pumps to Be Used.

Following in the footsteps of the Drainage Commission, the Sewerage and Water Board recently let contracts for a number of electrically operated pumping stations, located at various points on the main sewer to be built in the city of New Orleans. The power is to be generated at one of the pumping stations and transmitted to the others through a high-tension line enclosed in a conduit which is run immediately above the main sewer and built as a part of the sewer. The Sewerage and Water Board did not award contracts for complete pumping stations, but contracted first for the machinery only, requesting contractors to submit competitive designs. After the design was selected pumping stations were to be designed to accommodate the machinery contracted for. In this way the board aims to prevent any difficulties arising from forcing the machinery maker to build pumping stations which are out of his regular line, or forcing the general contractor to be responsible for machinery which he does not design.

Much to Recommend the Electrically Operated Pumps.

There are several pumping systems for drainage and irrigation purposes operated by electricity which are now being constructed or which are in contemplation in the southern states, and the prospect for a considerable increase in the amount of this work in the future is good. Electrically driven pumps for the substations forms a part of the sewerage plan of the city of Havana. This method of pumping sewage and drainage water recommends itself most strongly from the points of view of reliability and economy. The electrical matters which require the most attention are the proper protection of the line, because the machinery must be infallible during severe storms, and proper provision for starting the machinery where synchronous motors are used. This last provision is of the greatest importance, but the subject may be attacked from a mechanical rather than an electrical standpoint by so designing the station that the machinery does not have to start under load. Much more attention is required in the design of pumps for this kind of service, as the efficiency which is theoretically possible at the pump itself under the varying conditions of actual service is very much higher than the all-around efficiency that has actually been achieved up to the present time.

TWO MODERN DEVELOPMENTS.

The exposition given of the steam turbine during the recent convention of the American Street Railway Association, at Saratoga Springs, N. Y., was good and convincing. Mr. Emmet's paper, with the attending discussion, supplies what has been looked for eagerly by central station men. Facts covering actual commercial performance appeal to the manager of the light and power factory as no amount of theorizing will ever do—and facts came forth in good measure covering several plants. As regards the Chicago installation by the Commonwealth Electric Company, while conclusive results have not as yet been obtained, the preliminary tests are most reassuring and full of the promise of complete success.

A Single-Phase Railway.

It is a pleasure to be brought closely in touch with elements, which, of a certainty, are contributing an important quota to progress in great branches of the electrical industry. The delegates to the convention had this pleasure when enjoying a ride on the single-phase repulsion motor, experimental railway car equipment, which runs out over a good stretch of track along the canal at Schenectady. Under the conditions imposed the car accelerated smoothly, ran evenly and was under perfect control. The motors showed no indications of sparking at the commutators while running, although the latter were somewhat pitted from the effects of previous service. In the light of what we know of the three distinct systems that are now under process of rapid development, we can but feel that ultimate success of the single-phase railway, especially as applied to interurban and trunk line service, is well-nigh assured. What a prospect—to add to the present comforts of a trip from New York to Chicago, the pleasures of a "trolley ride"!

REASONS AND REMEDIES FOR MUNICIPAL OWNERSHIP.

Municipal ownership of electric light plants is increasing in the United States. Statistics, as far as they are available, indicate that the great majority of these plants have been acquired within the last decade.

Statistics for a Single State.

The complete statistics for a single state, Massachusetts, as recorded in the annual reports of its gas and electric light commissioners, show that, compared with a single municipal electric light plant on June 30, 1892, there were seventeen such plants on the like date of 1902. At the earlier of these two dates the investment in the single municipal electric plant was $15,000, and on June 30, 1902, the total investment in the seventeen municipal plants, three of which included both gas and electric equipment, was $1,828,708. In the three combined gas and electric plants the investment was $467,711 on the date last named. Late in 1902 the city of Holyoke, Mass., acquired both gas and electric plants at a cost of more than $700,000.

Thirteen Municipal Plants in Large Cities.

Complete figures showing the rate at which municipal electric plants have increased are not at hand, but this can be done for comparatively large cities. In the bulletin of the United States Department of Labor for September, 1902, it was shown that thirteen cities, of more than 30,000 population each, had municipal electric light plants at that time. The names of these cities, arranged according to the years in which their plants were acquired, are as follows:

Chicago, 1888; Little Rock, 1888; Topeka, 1888; St. Joseph, 1889; Allegheny, 1890; Wheeling, 1892; Tacoma, 1893; Galveston, 1894; Detroit, 1895; Taunton, 1897; Columbus, 1898; Grand Rapids, 1899; Springfield, Ill., 1900.

Many Towns Have Municipal Plants.

This list of cities with over 30,000 population each that have municipal electric light plants gives no adequate idea of the growth in the number of such plants, because this growth has been mainly confined to small cities and towns. Massachusetts offers an example of this fact, for of the eighteen municipal electric plants in that state, only three, those at Taunton, Chicopee and Holyoke, are in the cities, the other fifteen plants being owned by towns.

Municipal Plants Constitute Large Part of Total.

The extent of municipal activity in electric light plants throughout the entire United States is brought out for the first time by the recent bulletin of the United States Census Office on the electric light and power industry. According to this bulletin, of the 3,619 central electric light stations in the entire country, not counting electric railway stations that do some lighting, 815 were operated as municipal plants on June 30, 1902. The number of municipal plants was thus 22.5 per cent of the total, and the investment in these municipal plants was $22,020,473 or 4.3 per cent of the entire investment for all the lighting systems.

Development More Rapid in Small than in Large Towns.

Comparison of the percentage of municipal plants to the total number of lighting stations with the percentage of the total investment that is found in these plants, that is comparison of 22.5 with 4.3 furnishes another proof that the development of municipal electric plants has been much more rapid in small than among large places.

The Political Significance.

The fact last noted is of especial interest in an effort to determine the cause of this municipal activity in electric lighting. It has been thought by some that hungry politicians looking for jobs are the most potent factors in the development, but this idea hardly stands the test of the fact just stated. It will hardly be contended that politicians are more powerful in the local affairs of small than of very large places, or that the New England town meeting, where the majority of all the town's voters rule, presents a particularly good field for jobbery.

Municipal Plants Due to Popular Demand.

Probably it is far nearer the truth to say that people in general have got an exaggerated idea of the profits to be made in electric lighting, and that towns, being more influenced than large cities by popular ideas, have, therefore, more frequently invested in municipal lighting plants. To many persons, at least, it will appear on a little reflection that the movement toward municipal electric plants is based mainly on the desire to make or save money for the town or for consumers.

Remedy Is Education.

If this is true the evident remedy is education. Make the accounts of electric light companies so plain and so public that all who care to read may know how much and how little there is in the business. Such a course involves no danger to the interests of the great majority of electric light companies, for these companies are seldom making more, and frequently making less, than that fair return on the value of property which the Constitution of the United States guarantees to those engaged in public service, in spite of any attempted regulation of rates.

If the secrecy of accounts of electric light systems continues and over issues of securities based on them is not checked, it is hard to see how the popular error as to large profits in this line of business is to be mended.

An Ineffective Law.

Some have thought that laws which force cities and towns to buy out existing electric light plants before engaging in like enterprises would check municipal activity along this line, but this has not proved to be the result in Massachusetts. Every municipal plant save one in that state has been acquired under a law that requires a city or town to purchase existing electric plants within its limits, at the election of their owners, before a similar plant is established.

Victories Not to Be Won by Selling Out.

Victory for private enterprise can not be won, however, by retreat. To sell out the plant of a private company to the city or town and then quit the field is to give up the fight. Such a course may be the better part of valor where two competing private companies are concerned, for in that case ability to stand financial loss is the only limit of competition.

When the competition is between a private company and a city or town other considerations come in. Taxpayers will not long submit while electrical energy is sold to consumers below cost. Moreover, legal means are not wanting to restrain officials who waste public money in unfair competition.

Municipal Plants Not Necessarily a Menace to Private Enterprise.

In eight cities and towns of Massachusetts where there are municipal electric plants gas companies do a paying business, and in several of these places a part of the electric lighting is done by private companies.

Municipal lighting plants at Chicago and Detroit have not proved to be a serious menace to private electric corporations in these cities.

Shop Testing of Motors and Generators for Commercial Service—I.

By Bertrand B. Abry.

IN THE production of electrical apparatus the natural sequence of operation is: design, manufacture, test.

In general, tests may be divided into two classes, namely, those of a full and complete nature as applied to new designs, and those of a less complete and more general nature, applied to machines which have become standard and are being built in large numbers. In the case of a new machine, a complete test is made, for two purposes. First, to prove the design; second, to prove the manufacture or the process of building the different parts into the whole. In proving the design the actual electrical performance of the apparatus is determined. Proving the manufacture determines the quality of workmanship and material and the perfection of mechanical details.

In shop practice certain standard tests have been adopted for new types of machinery. Such tests may or may not be applied in detail to every machine built. But entirely new designs call for minute and complete tests. The electrical performance must be proven, as well as the workmanship and mechanical construction. A new type of motor, for example, will require all the standard tests, and very often a number of special tests. Particular features of electrical performance are expected, perhaps, in this new design. Hence, more than the usual number of tests may be necessary to determine these new features.

New designs become standard designs, in that it is not necessary to apply all tests when once machines so built have been thoroughly tested and calculated results verified. It is to be expected, then, that numbers of machines built from standard specifications from time to time, and alike in all respects, will give the same electrical results. This must follow if the quality of workmanship and mechanical construction, in other words, the process of manufacture, is uniform. In such cases the nature of the tests is more to determine the perfection of mechanical construction, the quality of material used, and the adjustment of the various parts. When these things bear their proper relation, the previously determined electrical performance follows.

Whether the series of tests be specific and complete or less extensive in their nature, there are a great many things to be borne in mind in connection with the actual conduct of the test, which, if properly cared for, necessarily aid in obtaining correct and satisfactory results. If neglected, not only unsatisfactory results are secured, but very often serious accidents occur, involving delay and extra expense.

In general, then, the satisfactory carrying on of tests of this kind makes it imperative on the operator that he be thoroughly familiar with all the circuits and wiring. High-tension wiring especially should be thoroughly understood and carefully arranged. To facilitate the tests, an operating table—a table for carrying all the instruments, switches, and other auxiliary controlling apparatus—will be found very convenient and will lessen the danger of complications and accidents. Instruments should be carefully calibrated and a record of the calibration kept at hand for checking and correcting results. The instrument observations, and in fact all the observations made during a test, should be carefully preserved by themselves for future use in making calculations. Before starting any test, it is well to examine the machine itself. This will bring out mechanical errors of adjustment, balance, or omission, due to shop carelessness. It should include a close inspection of the brushes, oil rings, bearings, etc., so that all friction losses may be reduced to a minimum by proper adjustment of these various parts.

In the several articles which will follow, it is proposed to consider the usual shop tests as ordinarily applied to new designs of direct and alternating-current motors and generators, beginning with the direct-current generator.

I—THE DIRECT-CURRENT GENERATOR.

The compound generator is here suggested for consideration in the main, since tests on such a machine include all that might be desired in the case of a shunt generator. The usual tests made are as follows:

1. Resistance measurements, hot and cold.
2. Iron loss and saturation test.
3. Electromotive force regulation test.
4. Calculation of efficiency.
5. Temperature test.
6. Insulation test.

1. Resistance Measurements—Cold resistances are usually taken while preparing for the test, and hot resistances at the conclusion of a temperature run. The fall-of-potential method is the one generally employed in making these measurements.

Armature resistances can be obtained only when the machine is at rest. Make connections and arrange instruments as shown in Fig. 1. For small multipolar machines and railway motors, two copper brushes are used for passing the current through the armature. Each brush is made with its face a little narrower than a segment of the commutator and is arranged to bear on one bar only, insuring a better contact than the ordinary carbon brush. For measuring the drop, two steel points are used with voltmeter leads connecting to a low-reading voltmeter.

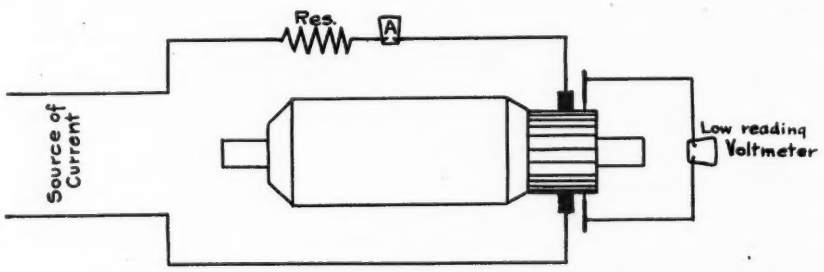


FIG. 1.—WIRING FOR RESISTANCE MEASUREMENT.

In large machines it is impracticable to use the copper brush. The regular carbon is employed and the drop measured by applying the steel points right on the surface of the commutator bar.

Take a series of five or six readings, varying the current each time by means of a suitable resistance rack, or lamp bank. In measuring armature resistances, the current should be kept as low as possible consistent with a satisfactory voltmeter deflection so as not to cause undue heating when making the measurements.

Shift the position of the armature once or twice and repeat. The average of the resistances figured from these observed voltages and currents should be considered as the armature resistance (cold) in further calculations.

The field resistance may be obtained while the machine is running or while standing still. Usually it is taken when at rest. For measuring field drops it will be necessary to use a higher reading voltmeter than in the case of the armature. As before, take a series of five or six readings, varying the current each time and noting the drop. Take the average of these results as the field resistance.

2. Iron Loss and Saturation Test—To determine the iron loss and saturation, the generator is belt-connected to a shunt motor and driven at its rated speed. Fig. 2 shows the wiring and connections. The observations made on such a test are as follows:

Motor.			Generator.		
Volts.	Amps.	Field Amps.	Speed.	Volts	Field Amps.

When ready to begin the test, bring the generator up to speed, and keep the speed constant throughout the test. This may be done by holding the line voltage on the motor constant and varying the motor field current as the load varies.

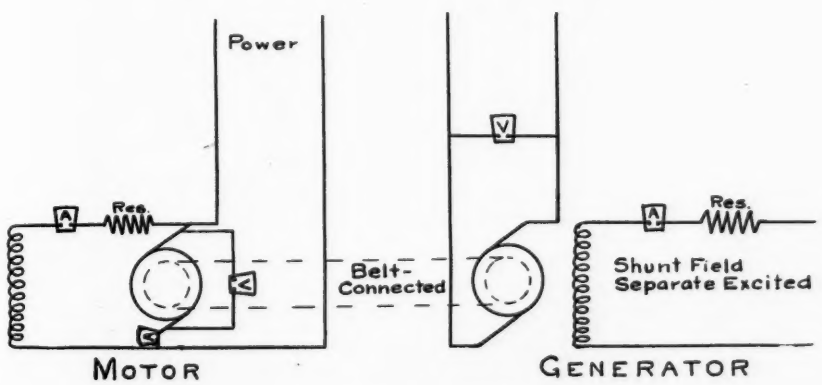


Fig. 2.—Wiring for Iron Loss and Saturation Test.

It is customary in making these shop tests to take ascending iron loss and saturation curves. That is, begin with zero generator field amperes and gradually increase step by step until a voltage say twenty-five per cent higher than the rated voltage is obtained. If there is any residual magnetism in the generator field, it will be noted that although the field current is zero the voltmeter needle will be slightly deflected. This reading should be recorded since it will constitute the first point on the saturation curve. The volts, amperes and field current of the motor should also be noted and recorded at the same time as well as the generator speed. After each successive observation the generator field current is slightly increased and a series of readings again taken. About every fourth or fifth increase in the field current it is advisable to again bring it to zero. If no abnormal conditions, such as undue friction, exist, the instruments should read practically the same as they did on the start. Any such abnormal condition may be detected by noting whether the motor amperes are the same or nearly so, as in the first set of readings. If results do not check, the trouble should be remedied and the test begun again. If the results do check with the first zero field current readings, the test may be continued. That is, increase the generator field current to a point slightly above the amount recorded just before opening the field circuit, and proceed.

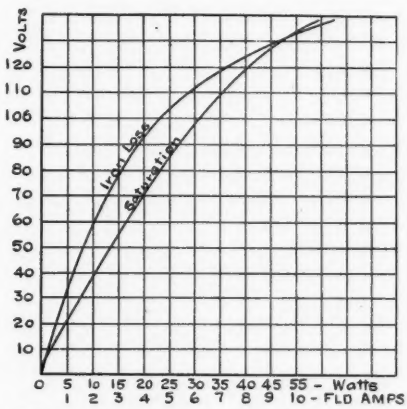


Fig. 3.—Iron Loss and Saturation Test.

In making an iron loss test on a direct-current machine, the brush friction and bearing friction and windage losses should also be noted. The watts lost due to brush friction may be determined in the following manner: After the last reading has been taken again reduce the field current to zero and make sure that the friction has not increased any so that a minimum motor armature current may be obtained. The energy expended by the motor in driving the generator under these conditions we may call the "no-load watts." Next raise the generator brushes from the commutator. Take another set of readings, keeping the speed constant at all times. The difference between the motor input in each case, that is, motor input with brushes down minus motor input with brushes up, equals brush friction loss.

To measure the bearing friction and windage, keep the generator running at constant speed with field current zero. Read the instruments. Then throw the belt off. The difference in the motor input, brushes up and belt on minus motor input, belt off equals bearing friction and windage.

After obtaining these results it remains to plot the curves. It will be seen from the above test that the generator iron loss is equivalent to the difference in the watts required to drive the motor with a field charge on the generator and zero field charge. The difference may be designated as the "watts lost."

From the test results we may calculate and tabulate somewhat in the following manner. The input to the motor (less field current), that is, armature volts by armature amperes, we will call the "motor watts."

Motor Watts.	Iron Loss in Watts or Watts Lost.	Generator.	
		Volts.	Field Current.

To obtain the watts lost compute the difference between the motor watts with zero generator field current and the successive motor watts with increasing generator field currents. In other words, the watts at any reading of the motor voltmeter and ammeter minus motor watts at no load (when generator field current is zero) equals the watts lost, or the energy expended by the motor in driving the generator. In tests where great accuracy is desired, it is customary to make an allowance for the C^2R loss in the armature of the driving motor, which should not be charged to the generator as iron loss. The columns of "generator volts" and "field current" are transferred directly from the test sheet. With these results in hand the curves may be readily plotted.

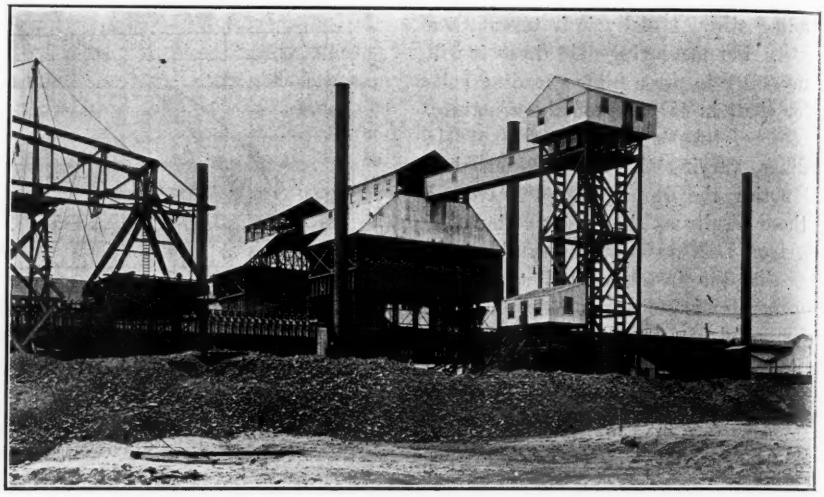
(To be continued.)

Coal Handling Machinery Driven by Electric Motors.

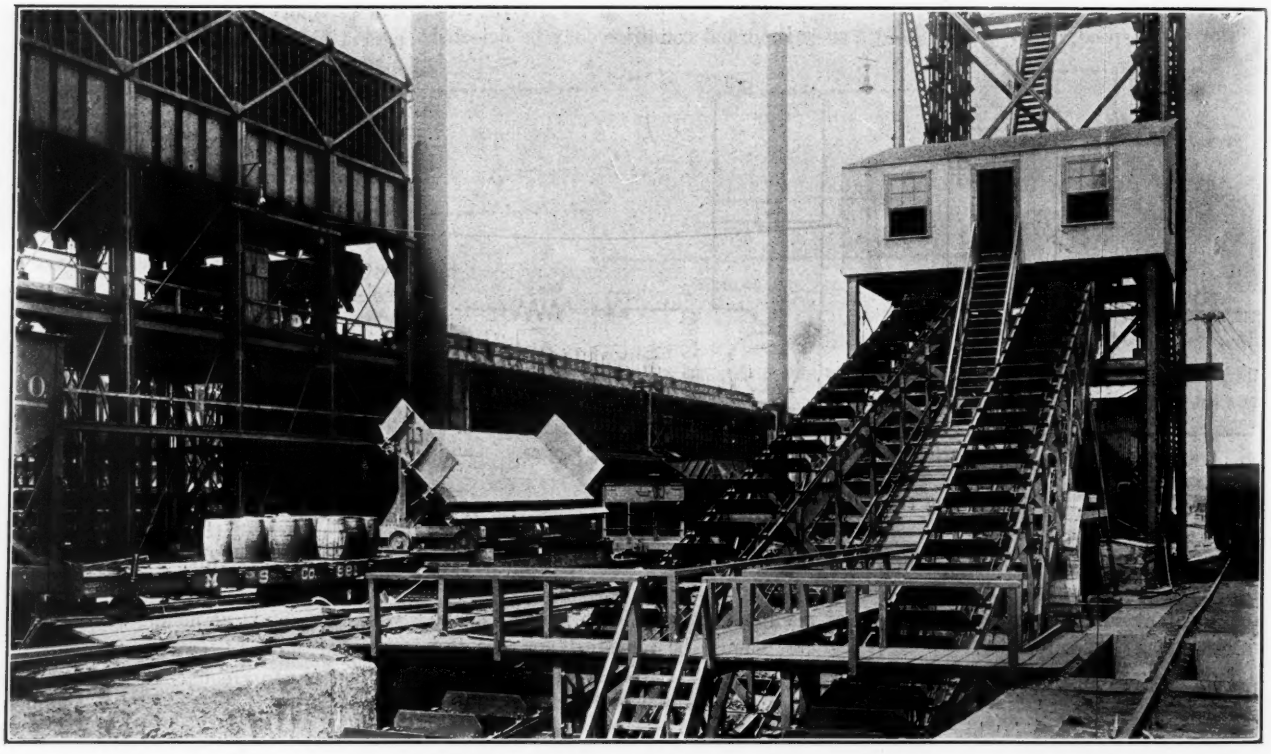
By D. A. Willey.

THE employment of electric service in handling and storing coal is well illustrated in the plant which has recently been installed at Sparrows Point, Md., in connection with the works of the Maryland Steel Company. To supply the necessary coke for its furnaces, the company has recently completed one of the most elaborate sets of coke ovens in the United States, representing the latest improvements in this apparatus. The coke is secured from bituminous coal of the ordinary run-of-mines grade, which is brought to Sparrows Point by train. It is not only resolved into coke but gas, as well as several other products, the coking plant having a capacity for producing 10,000,000 feet of gas every twenty-four hours.

The ovens are divided into four batteries, arranged in sets of two each, and require at least 1,600 tons of fuel daily, when all are in operation. To provide ample storage, it was decided to have the storage plant of 50,000 tons' capacity, the ovens being served by two elevated bins, holding 1,000 tons each. The apparatus installed for the various processes, forms one of the most complete automatic systems yet planned in this country, for the unloading of the cars, storing of the coal, assorting and crushing it, as well as elevating it to the supply bins and serving it to the ovens, are performed entirely by machinery operated by isolated motors, which secure current from the electric power station maintained by the company.



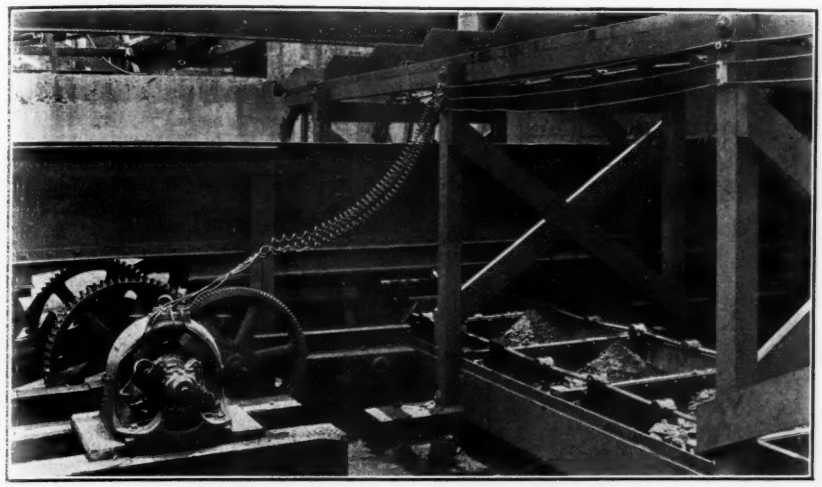
General View of Coal Pile and Handling Plant.



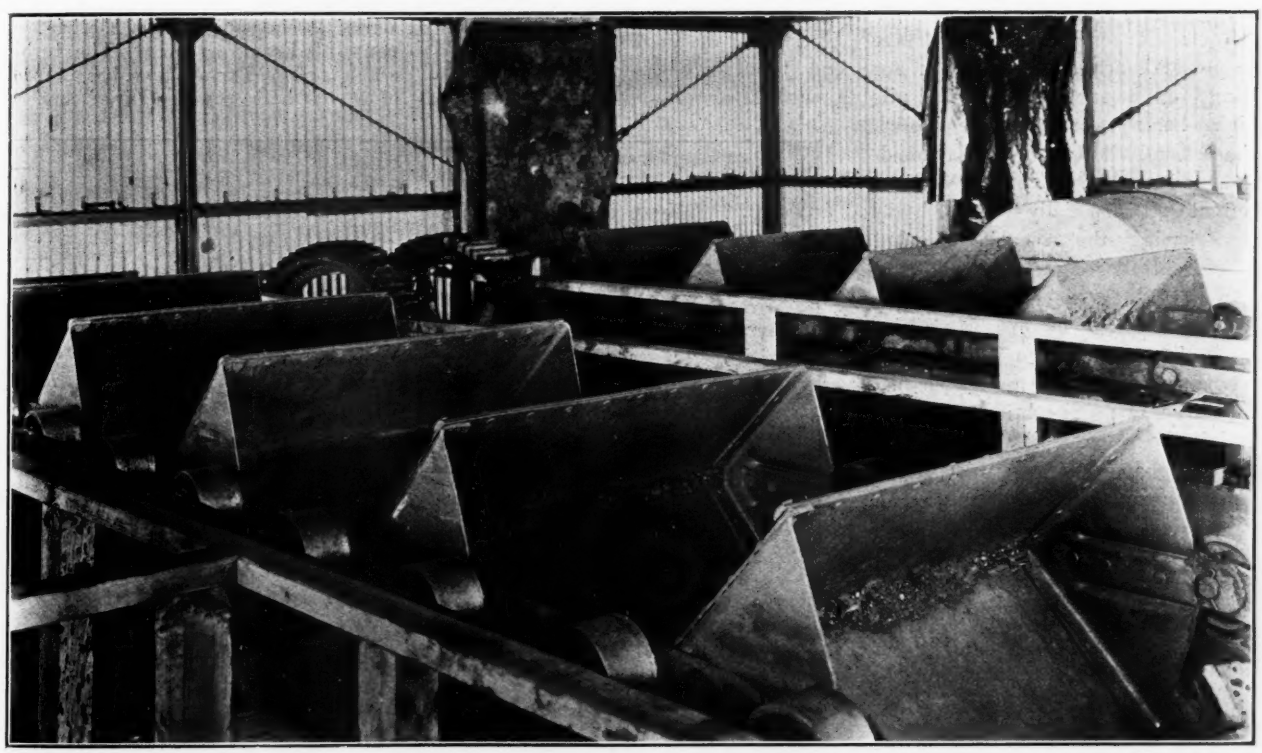
Elevating Conveyors Connecting with Track Hoppers. At the Left Is One of the Storage Bins and a Trolley Line for Transporting the Oven "Larries."

For the purpose of storage, the Dodge circular system has been employed, which comprises a swinging span of 280 feet maximum dimensions. This is operated by the suspended system, with which is connected a two-ton bucket of the clam-shell type which is used in loading and unloading. The system is so arranged that it will receive coal simultaneously from two cars and distribute it by means of the bucket to any part of the storage area. It is also reloaded from the storage plant and delivered directly through chutes to the system which conveys it to

the crushing bins and ovens. The conveying system, which is the principal feature of the entire equipment, is operated throughout by isolated electric motors. For serving the conveyors, four steel track hoppers have been installed, located on two tracks which are thirty-seven feet apart, the hoppers being equipped with feed gates which automatically deliver the coal in proper quantities to conveyors of the inclined scraper type serving the crushers. The crushing rollers are two in number, the rollers proper being forty-six inches in diameter and thirty-six inches in width and provided with fluted surfaces to increase their efficiency. The rollers are operated differentially to give the proper grinding effect. Before entering the crushers, however, the coal, which is received from the mines in the various sizes, passes over bar screens which separate the portion which is smaller than one inch in size. Consequently the lumps which are an inch and over are treated by the crushers.



METHOD OF INSTALLING MOTORS.



CONVEYORS SERVING CRUSHING MACHINERY.

The finer coal and that which has passed between the rollers is conveyed by scraper conveyors to the two elevators, each having a capacity of 160 tons per hour. Therefore in continuous service the elevators will fill the serving bins in less than seven hours. The buckets connected with the elevators are what are known as the "V" type, each being four feet long, twenty-four inches wide, with a depth of twelve inches. They are attached to heavy steel link roller chains and deliver overhead in a belt conveyor which also automatically distributes the coal in the bins. It may be said here that the elevators are ninety feet in height. The endless belt is of sufficient capacity to transport the coal from both elevators when working simultaneously and fills the bins by means of a self-propelling tripper. Owing to the service required the conveyor belt is made of woven cotton, which is considered one of the most durable materials for this purpose. The trough of the belt, however, is made extremely shallow with a view of having the conveyor as flat as possible without sacrificing the capacity. As the photographs show the storage bins are at such an elevation above the oven plant that the fuel can be loaded into the serving cars by gravity and the ovens filled in a very short space of time.

In transferring the coal from the track hoppers to the elevating apparatus what is termed a reciprocating feeder is employed. It consists of a flat metal apron operating under the discharge opening of the hopper and is governed by a crank mechanism connected with the conveyor. The hopper is so arranged as to relieve the feeder of the weight of the material the hopper contains. The feeder is practically an automatic gate which controls the de-

livery of the coal in any size. By this method the services of a man to regulate the flow of coal from the hopper are not required and there is no possibility of jamming or overloading the conveyors.

Belt Conveyor and Chute for Loading It from Elevators.

The electric service for the storage plant proper is arranged as follows: For hoisting over the surface of the fuel pile an eighty-horse-power motor is employed, of the General Electric type, compound-wound, and working at 500 revolutions per minute. It is specially built for heavy service, having the solenoid type of switches, controlled by a foot lever. The overhead trolley for moving the reloading bucket, is operated by one fifty-horse-power, series motor of the Westinghouse 38B type, running at 500 revolutions per minute. To swing the bridge used for trimming the storage pile, the traverse motion is produced by two thirty-horse-power motors of the Westinghouse 12A type, operated by a series parallel controller, each protected by an individual circuit-breaker.

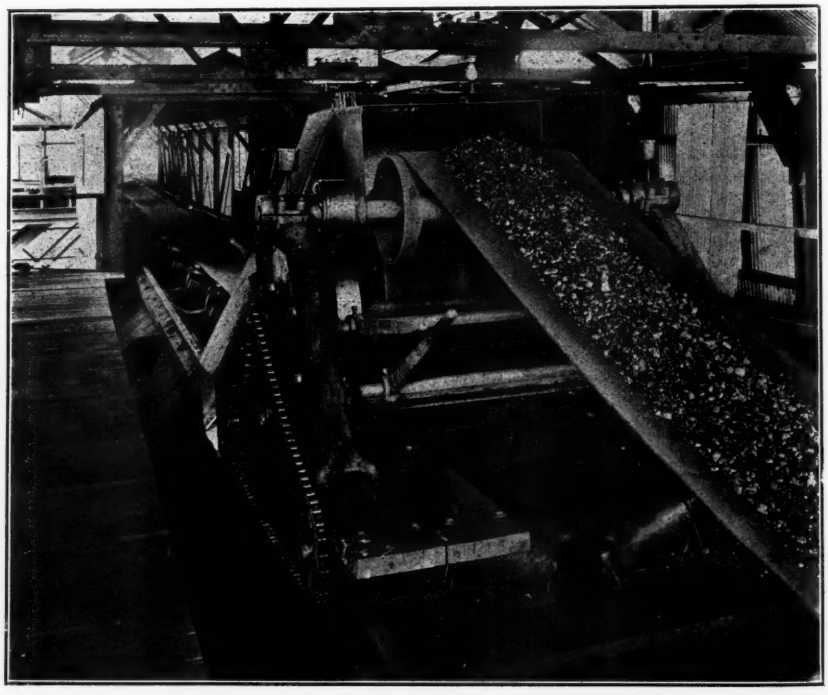
For the purpose of convenience, the handling plant is arranged in two divisions of equal capacity, so that one section can be operated independently of the other, when desired. The only exception is the conveyor from the elevator to the storage bins. The coal, as it falls from the cars, is received on the shakers, which pass it into the feeding hoppers. The shakers in each section are operated by a five-horse-power motor of the closed type. The conveyors running between hoppers and crushers are each served by a twenty-five-horse-power Westinghouse motor, of the open type, while each crusher is operated by a fifty-horse-power, compound-wound motor, of the open type. Each bucket elevator, connecting the crushers with the bin-feeding belt, is operated by a forty-horse-power motor of the same type, while the endless belt requires but one twenty-five-horse-power motor, although, as already stated, it is of sufficient capacity to handle all of the coal delivered to it from each elevating plant, when both are running at full speed.

The cars, or "larries," serving the ovens, travel upon a track elevated to such a height that their contents can be emptied into the coke ovens by gravity. They are hauled to and fro by an overhead trolley operated by a twenty-five-horse-power Westinghouse railroad motor.

The plant, which was installed by the Link Belt Engineering Company, of Philadelphia, has been in operation about two months, during which time tests have been made demonstrating its economical operation.

During one test when the coal was being handled at the rate of 220 tons an hour, both elevators being in service, it was found that the two conveyors required energy equal to twenty-five horse-power; when loading the two reciprocating feeders, 10.8 horse-power; the pair of crushers required thirty-three maximum horse-power; the elevators 34.4 horse-power, and the conveyor serving the storage bins 11.7 horse-power. Assuming that the expense per horse-power-hour is two cents, the actual power cost for this service would be but 1.05 cents per ton excluding manual labor. This has been found to be 0.8 cent per ton handled, making the total cost of operating the entire plant less than two cents per ton of fuel handled.

A large steam turbine driving two generators has been built by Brown, Boveri & Company for the Electric Company, of Essen, Germany. The turbine, which is of the Parsons type, has a capacity of 10,000 horse-power. Direct-connected to it are a direct-current dynamo of 1,500-kilowatt capacity at 600 volts, and a polyphase generator of 5,000-kilowatt output at 5,000 volts pressure. The guaranteed efficiency of the set is one kilowatt-hour for 15.4 pounds steam.



Endless Belt (Loaded) for Serving Overhead Bins.

Important Decision on Tesla Split-Phase Patents.

Judge Archbold, in the United States Circuit Court, Eastern District of Pennsylvania, has just handed down a decision in the suit of the Westinghouse Electric and Manufacturing Company *vs.* H. C. Roberts and the Sangamo Electric Company, which has an important bearing on alternating-current meters and fan motors. The suit was under the so-called Tesla split-phase patents. The defendants' device against which suit was brought was the Sangamo electric meter. The Court, after a careful review of the testimony, decided that the complainant had proved satisfactorily that Tesla's date of invention preceded that of Ferraris's and others, and that the device in question was an infringement.

The importance of these patents is great, as some of the most successful alternating-current meters and motors of small size are tributary to them.

The following is an abstract of Judge Archbold's review of the testimony:

The patents in suit and those on which they are based, or which are kindred to them, have been so fully considered in previous cases which until recently have also been uniformly in their favor, that little is left to be brought forward with regard to them.

The derivitive patents in suit, numbers 511,559 and 511,560, were first considered in the Dayton fan and motor case, 106 Fed. 724; affirmed in 118 Fed. 562, and a decision rendered in substantial accord with those which had preceded it. One defence there, as here attempted to be made, was that it involved no inventive skill when once the practicable use of alternating currents of different phase was established, to substitute the dephased split current which was a well recognized equivalent; but it was not so held, nor can it be here.

The patents in suit were also before Judge Lacombe in the Westinghouse Electric and Manufacturing Company *vs.* the Catskill Illuminating and Power Company, 110 Fed. 377. In addition to the attack made upon them in other cases, it was further urged that, in a paper read by Professor Ferraris before the Royal Academy of Sciences, of Turin, Italy, March 18, 1888, a portion of which was published on April 22 following, at Milan, in *L'Elettricita,* not only was there a full disclosure of the transmission of electric power by means of alternating currents of different phase, but also the use for the same purpose of a dephased split current derived from a single source, the same as in the patents in suit. Upon a due consideration of the opposing proofs the invention of Tesla was held to be carried back of this publication; but on appeal, the decision was reversed, the evidence brought forward by the complainants not being considered sufficient for that purpose; 121 Fed. 831; a conclusion which was followed by Judge Colt in a case by the same plaintiffs against the Stanley Instrument Company, in the first circuit, not yet in print. This, and the matter of infringement, are the overshadowing questions in the present case.

The Ferraris publication, as we have seen, was April 22, 1888, and the patents in suits were not applied for until December 8 following. To relieve from this apparent priority the invention has, therefore, to be carried back of the earlier date by competent and convincing evidence. That Tesla, early in May, 1888, had a complete grasp of the split-phase idea is established by his application of May 15 for patents, Nos. 511,915 and 555,190, which embody it, the same that were before Judge McPherson in the Scott & Janney case 97 Fed. 582, already alluded to. This is important evidence which can not be contradicted and I, therefore, start with it. Not only is the invention beyond question carried back by it to the date named, which is within twenty-three days of the Ferraris publication, but from the known order of events, a patent not being able to be worked out in a day, ground is thus persuasively laid for an earlier date if there is any fair evidence to warrant it. In the face of it, I hardly see how we can doubt the accuracy of Mr. Page's statement that Tesla disclosed to him the principles of the invention somewhere in the first part of April of that year. His testimony on this point is specific and convincing. In the fall of 1887 and spring of 1888, as he says, he was engaged in developing in the Patent Office a number of Tesla's inventions, and among them the polyphase motors and transformers which were patented May 1, 1888. These were prosecuted to an allowance in the early part of April, the final fees, as shown by the books of the firm of which he was a member, having been forwarded to Washington on April 6. After having secured the allowance of this group and made arrangements for similar applications in a number of foreign countries for patent to issue simultaneously therewith, Tesla gave him the material for application one feature of which was the inducing of one current from another in the operation or construction of a motor, and in this connection disclosed to him his plan for operating his polyphase motors by means of a single split-phase circuit. Startled by this revelation and questioning whether the claims which he had drawn in the pending cases would protect this new improvement he had a long conference with Tesla, getting from him all that he could as to the different ways he proposed to operate this two-wire system. It seems to me convincingly established that prior to April 22 the date of the Ferraris publication, Tesla had disclosed to Mr. Page, his solicitor, the principle of his split-phase adaptation.

But the testimony of Mr. Page is by no means all there is upon this subject. Mr. A. S. Brown formerly connected with the Western Union Telegraph Company, became interested in the summer or fall of 1887 in bringing out the original Tesla motor; and he testifies that once when it was first brought to his notice it occurred to him as a great objection that it required two separate currents; not long after which Tesla showed him how it could be operated on a single main line from the generator.

So far as I have considered only the proofs, about which no question can be raised, and basing my decision solely upon them, I am satisfied that the patents should be sustained.

The question of infringement still remains. At the time suit was brought, the defendant, Roberts, was engaged at Philadelphia in the sale of Gutmann recording wattmeters, as agent for the Sangamo Electric Company, of Springfield, Ill., by whom they were made.

It is contended that a meter is not a motor, and that on this ground of itself no infringement can be charged. No doubt the strict object of a meter of this class is to measure and record the element which passes through or actuates it, gas, water, the electric current, or whatever it may be; but where, as here, it is, in mechanical construction, nothing more than an adopted motor with meter attachments, it can not escape infringement on that plea.

The Tesla motor as an invention, was first in its own peculiar field, and is entitled in consequence to a liberal application of the doctrine of equivalents, and of the substantial equivalency of the defendants' device I am fully convinced. The significant thing in each is the conjoint or resultant action of the two opposite sets of poles, the magnetic influence, whether of attraction or repulsion, waxing and waning, and shifting progressively about the armature, of the existence of which there can be little doubt. It is persuasive of the equivalency of operation which is so contended for, although by no means conclusive of it, in a patent applied for by Tesla May 20, and granted December 3, 1889, this equivalency is assumed without explanation as being within the terms of the invention. Other confirmations of the equivalency of the two arrangements with that of a Tesla motor, as well as with each other, could be drawn from this record, but these must suffice. They establish to my satisfaction the general infringing character of the defendants' meter as is charged.

Finding therefore that the patents in suit are valid and have been infringed, a decree is directed in favor of the complainants in the usual form, with costs.

RECENT STEAM TURBINE DEVELOPMENTS.[1]

BY W. L. R. EMMET.

In this paper will be described the 5,000-kilowatt turbine installed for the Commonwealth Electric Company, Chicago, Ill. This machine has been connected to its regular equipment of boilers and condensing facilities. It has been started without any hitch or delay and has been operated repeatedly at full load and under a variety of conditions to test its performance. It has operated with a wonderful steadiness and perfection, has governed perfectly from full load to no load with only two per cent speed variation, and has in every respect shown itself to be a thoroughly desirable operating machine. A test of steam economy was also very carefully conducted on this machine, very perfect facilities for weighing water and maintaining a steady and accurately measured load having been provided. Unfortunately, the results of these tests were found afterward to be entirely indefinite, since a large leakage of circulating water through a misplaced valve into the steam space of condenser was discovered, which water had been weighed in connection with the condensed steam. The machine is connected so that the condensed water passes from the hot well through a heater and is pumped directly back into the boiler. The water returned to boilers was, of course, entirely free from oil and quite clear except at light load when the leakage from the river appreciably discolored it. The plant operated at full load with four 500-horse-power boilers fired out of the eight which have been provided for each machine.

In order to properly understand the significance of the successful starting of this machine, it is necessary to review the history of its design and to compare it with engines of other types. After the experiments with Mr. Curtis's steam turbine inventions had proceeded for several years, certain experimental results were obtained which seemed to justify the production of commercial machines and it was decided to build a commercial machine for use in the Schenectady works. A 600-kilowatt machine with horizontal shaft was designed, the mechanical arrangements being in most respects in accordance with the plans which Mr. Curtis had formed previous to that time for building the turbines. This machine was built and tested nearly two years ago.

[1] Abstract of a paper presented at the twenty-second annual convention of the American Street Railway Association, Saratoga Springs, N. Y., September 2, 3 and 4.

These tests showed a high steam economy and it was very soon after decided that the performance of this machine justified the building of other commercial machines which could safely be relied upon to perform as good or better results. The question of mechanical design for these larger machines then became a matter of first importance. The steam economy could safely be expected to conform closely to that of the machine which had already been tested but the whole question of cost and commercial desirability depended upon the mechanical construction adopted for accomplishing the desired results.

It was decided at this time to build a steam turbine unit as large as the largest engine-driven generating unit in the country, and as the result of this decision the design of the machine now in Chicago was made up after a great amount of thought and study. This design embodied many very radical features as compared with other engines, turbines or machines of any character. The shaft is vertical; the whole weight of the revolving part is borne by an oil film delivered by a pressure pump to the lower bearing; the delivery of steam to turbine is controlled through a system of electrically operated individual valves worked by a small controller something after the manner of multiple unit train control systems; the centrifugal governor moves the controller. The revolving field is mounted upon the same shaft with the turbine wheels, and the stationary portion of the generator is supported by the stationary portion of the turbine, the whole building up into the general form of a vertical cylinder about twenty-five feet high and about fourteen feet in diameter. The total weight of the turbine and generator is about 400,000 pounds and its capacity is 5,000 kilowatts at full load. It is capable of running at about seventy-five per cent overload condensing and at nearly full load non-condensing.

The question as to why the vertical shaft design was adopted for this unit has often been raised and many doubts and criticisms concerning it have been expressed. It is not easy to explain all the reasons which lead up to its adoption but it may be said that the compactness and simplicity of this unit, which are its most marked characteristics, are largely due to the merits of this design. With the vertical shaft arrangement all lateral strain is removed from the bearings which align the shaft and all deflection of the shaft avoided with a minimum number and length of bearings. This matter of properly supporting shaft and keeping it exactly central and in perfect alignment is an important one where small clearances are desirable with a large diameter in the revolving part. To carry such weights as are necessary in the revolving part of this large unit many very large bearings would be required if the shaft was in a horizontal position. An elaborate system of forced lubrication with artificial cooling would be necessary in connection with these bearings and a failure of any of these bearings would occasion serious danger to the operation of the machine. If the machine were built in a horizontal position it would be very difficult to so support the wheels that their clearances would not be affected by sagging of shaft or looseness in bearings, and also it might be difficult to place them with such a relation to each other that the clearance would not be affected by expansion of the shaft. In the vertical design the space between wheels is reduced to a minimum, the supporting structure is perfectly symmetrical and can not be in any way distorted or put out of line either by mechanical or steam pressure strains or by the effects of expansion.

The oil pressure step bearing at the foot of shaft supports the whole revolving element in a balanced position by perfectly symmetrical suspension and preserves the exact relation of level between the stationary and revolving parts. As long as this step bearing fills its functions a multitude of mechanical difficulties and uncertainties are overcome.

Experience with a number of machines has fully justified our decisions in this connection. The bearings have run perfectly with an inappreciable amount of friction and, when properly supplied with oil, operate with perfect steadiness and regularity. In one respect these bearings have agreeably surprised us, that is, they have been much less injured by stoppages of oil than we expected. In the course of our experiments imperfect pumping arrangements have been used and repeated failures of the oil flow have been experienced, but in no case has any damage to the machine resulted. Even the cast-iron blocks which constitute the step bearing, are as a rule not destroyed. Our experience has been that they cut and heat when the oil supply is removed, but in all cases the surfaces have ground themselves to an operating condition after the oil flow is renewed so that the machine could continue in operation. This might not always be the case, but it seems quite certain that the damage could never

be as serious as that which would result from a failure of the lubrication system where heavy weights are carried on high-speed horizontal bearings.

In our newer machines we are providing a heavy stationary collar below the lowest wheel which can be used to support the wheels in case the step bearing is removed and which would serve as a brake to bring the machine to rest in case the step bearing should cut enough to allow the wheels to settle to a dangerous degree. Our experience has been that there is very little tendency to settlement of the shaft in case of such cutting and this latter function of the collar will presumably seldom be called into requisition.

The oil for step bearings and also for the upper bearings of machines is delivered by a small electrically driven pump which operates continuously from the exciter circuit. In most of the large plants where we are installing turbines we have recommended, in addition to these electrical pumps, a weighted accumulator with steam pump arranged to keep it full automatically. This accumulator with its steam pump affords an automatic reserve for the lubricating system. Its capacity is such that there would be ample time to shut down the units even if everything in the station should be stopped by the bursting of a boiler or steam pipe.

One important matter in connection with the introduction of our turbines has been the establishment of proper condensing facilities in order that the great benefits of high vacuum might be realized to the greatest possible extent. In turbines which we have tested the steam consumption has been reduced from six to seven per cent for every additional inch of vacuum above twenty-five inches. Such a reduction is, of course, very important and justifies large expenditures upon condensing apparatus. The fact that the turbine may be better than a condensing engine with equal vacuum must not be considered a reason for assuming that a condenser which is good enough for the engine is also good enough for the turbine. The selection of condensing facilities should be governed by the economic possibilities.

We have recently designed for some of our large new turbines surface condensers which themselves constitute the base and supporting structure of the machine. These condensers are of very ample cooling surface and are so arranged that the maximum degree of vacuum is obtainable with a given amount of water. One feature of our turbine which is very advantageous in obtaining a high vacuum is that it can be easily so arranged that the air leakage is reduced to zero. The two points where the shaft passes through the casing are fitted with packings which are kept sealed by steam. Another advantage is that there is no oil in the steam and consequently that the exterior of condenser tubes is kept perfectly clean. Several turbines with condenser bases are now being built and it is probable that there will be a large production of machines of this type.

I have mentioned above that no oil comes in contact with the steam in these turbines and I need hardly call attention to the great importance of this fact. The condensed water can be delivered directly back to the boilers and all possibility of trouble in boilers from oil, dirt or scale is eliminated. Even in plants where feed water is good and cheap, this constitutes a great advantage since a considerable amount of heat is saved by using the condensed steam on account of its higher temperature. There is, however, no such a thing as perfectly pure and clean natural water and there are few boilers that in their average working condition are perfectly clean. Cleanliness in boilers improves circulation and evaporation, prolongs life and constitutes, therefore, a very distinct and definite advantage.

As the work of developing these designs has advanced, experience has shown the possibility of better and simpler methods and the steady continuance of experiments has extended our knowledge of the theoretical possibilities. Consequently, new designs have been proposed and developed and we now have in production a large number of machines which we consider greatly superior to those which are now being put into service. This process of experimental development will continue and the production and test of each new machine will extend our knowledge and make possible further advances.

THE GAS ENGINE VERSUS THE STEAM TURBINE.

A SYMPOSIUM OF THE OPINIONS OF SEVERAL PROMINENT OPERATING AND CONSULTING ENGINEERS.

JOHN I. BEGGS, MILWAUKEE, WIS.

The tendency of the time is for consolidation of electric railway and electric lighting properties in the various cities. It is a natural combination in the interests of the public; the public gets the benefit of it. There has been formed in the West a large manufacturing establishment to produce coke for domestic use, furnace and foundry use. This company has built eighty ovens, at the present time, and has some twenty-eight acres of land, and in the manufacture of the coke its gas becomes a by-product. It has already taken the initial steps in an attempt to acquire the franchise in that city for the purpose of distributing and marketing its by-product—in other words, it will either compete with the gas companies, or put in large electric generating plants and dispose of its electric current at such a rate as we could not approach or hope to displace with other classes of power. Therefore, it becomes important to the members of this association that if possible they put in generating units so as to take at small cost from these coke ovens their by-product of gas and thereby keep them out of the market as a competitor to our business.

C. O. MAILLOUX, NEW YORK.

It so happens I have had occasion to investigate the question of gas engines, as well as the question of turbines, in my professional capacity to my clients, and I think I can sum up my view of the applicability of the gas engine by the old, trite saying—"Circumstances alter cases." I find it makes all the difference in the world whether you get gas for nothing or have to produce it. In a case where the gas costs nothing, as at Buffalo or in places similarly situated, or the gas is obtained at a cost which is below twenty cents per 1,000 cubic feet, I think gas engines will undoubtedly be more economical, or at any rate as economical, as steam turbines, especially when coal is relatively high. But when the power producer is compelled to produce his own gas, the situation is quite different. I had occasion to institute an interesting comparison recently, in the case of a plant of 15,000 kilowatts, where I received estimates from a concern that offered to do the entire work by gas engines—the same gas engine as is used in Buffalo—and where I also had estimates based upon the use of steam turbines. It is for that reason I thought I would speak of this comparison, since it is a case in point. I found as the first point in the comparison, that in the gas engine system the largest unit was about 2,000 horse-power. It would be necessary to have something like ten units, and therefore a larger building would be required for the plant, and a larger maintenance account, because the number of units is greater. The gas engine is not a simple device, and has a certain maintenance account. I found also, in order to get the economy promised to me by the representative of the system, that I would have to go into the chemical business—in other words, I was told that out of the combustion of the gas or manufacture of the gas I would get certain chemical by-products and would have to go into the chemical business to sell them. I understood that in an installation of 3,000 kilowatts there would be something like $50,000 a year or more recovered in the form of chemical by-products. The principal objection was that it required an initial outlay of over $1,000,000—that was the crucial thing. If you consider the interest upon the extra initial

investment—the depreciation, insurance, taxes, and all things which constitute fixed charges—you will find you must have greater efficiency and economy in your coal to come out even. In that particular case, I found that instead of coming out $100,000 ahead as against the steam turbines, we would be more nearly that much behind each year. It is needless to say I did not advise my clients to adopt the gas engine plant in that case. On the other hand, I had a case of a pumping plant in Mexico, where coal is $15 a ton, delivered on the mountain 700 miles from the nearest coal mine. I found in that case a gas engine, operated with producer gas, though it might cost more than the steam turbine, would pay for itself in something like three or four years. The pumping duty is constant and it lasts twenty-four hours a day. There is an ideal load curve, which is an exactly suitable condition for the best economy to be obtained by the use of the gas engine. I had occasion to investigate a case in Arizona where the power was to be used for lighting and traction, and found in that case that the cost was very nearly even. The company was one which produced gas as well as electricity. It makes the gas and could procure it at the lowest cost, but after a careful investigation it decided to adopt steam turbines. Further investigation in the case shows that in the present state of manufacture the cost per kilowatt of the gas engine outfit is at least twice that of the steam turbine outfit. I have had a station operating under my direction which has been installed for a year, running one unit per year and for the last five or six months running two units of 400 kilowatts each. The results have been extremely satisfactory and we have recently ordered two units of 3,000 kilowatts each. I do not think I am telling any trade secrets if I state that the cost per kilowatt for the last two units ordered is under $28, for the unit installed, not including the piping or condensers. The great point in the steam turbine which appeals to me, as the result of my experience, is that it enables the station equipment to be greatly simplified, not only in detail, but also those things which eventually tell on the maintenance. You have fewer parts; there are no adjusting parts and various other things of that kind are much simpler in the steam turbine. But there is one other feature which is, I think, of the greatest utility, and that is the ability to apply superheat in the use of the steam turbine. I pointed out in the discussion last year that there is no limit to the superheat that you can apply in the case of the turbine; there are no conditions of lubrication to impose limitations; no packing, nothing to prevent you from applying all of the superheat possible to get. The steam turbine is related to the question of the design of the plant in another way—heretofore we have been accustomed, when we wanted a higher efficiency in our steam-producing outfit, to consider the introduction of fuel economizers. We have also been obliged to resort to extremely high steam pressures. We find with the steam turbine, allowing yourself ample superheating, with a moderate steam pressure, 150 pounds, which is high as compared to ten years ago, but low as compared with the practice of to-day—with a steam pressure of 150 pounds and superheating up to 600 degrees, you are enabled to get as good economy as you would get with perhaps 175 or 180 pounds of steam pressure, using fuel economizers. The cost of the station is less, expense of running much less, and all things considered the cost of producing power is much reduced.

J. G. WHITE, NEW YORK.

I assume that many others are in practically the same position as myself in reference to this important subject, and that is that probably most of the people who have given the subject any considerable attention appreciate the necessity of high vacuum and high steam pressure, which is obtained by the turbine, and also the advantages of reduced space, saving in initial investment, saving in oil, and other supplies—but what most of us want to know is what can be depended upon as to reliability? Can we install steam turbines to-day and be certain that they will start off without serious interruption, or at least that after a few weeks of operation they can then be depended upon to take up the regular load and carry it day after day? I understand that at Newport there are two turbines in operation, the original one which gave considerable trouble in its experimental stages, which is now said to be down to a regular working basis and running with considerable regularity, and also a second unit which I understand is in operation and running satisfactorily.

W. L. R. EMMET, SCHENECTADY, N. Y.

We have had experience with two turbines, one of 600 kilowatts in Schenectady, which is of the older type, and a vertical shaft turbine at Newport, which is of the newest type. The machine at Schenectady involved no radically new or peculiar mechanical devices, and was put in service two years ago and has run almost continuously without having any interruption of service or trouble of any kind. The machine located at Newport has carried its load continuously, and it is only through an excess of conscientiousness that in the paper I tell you anything of the troubles we have had, because there have been practically none which interrupted the service. We have made a record of all stoppages, and I think there were three stoppages which interrupted the service in Newport, between June and September, and the longest stoppage was less than twenty minutes. This, however, was inspired by a certain amount of trouble going on in the valves which had to be corrected from time to time. However, the Newport machine as it stands, if it had to be kept in its present condition without improvement, and simply maintained by the renewal of those valve parts as they give out, would be maintained and run at a small fraction of what it would cost to maintain any reciprocating engine of equal capacity. On comparing turbines and gas engines, it is purely a question of the cost of fuel; that is, with the turbine in its present state of development. The actual fuel economy of the gas engine in its greatest state of perfection is greater than that of any steam engine heretofore produced. However, the very highest results obtained so far with steam turbines, in the matter of fuel economy, that is, actual consumption of combustibles, are not so far below the thermic results obtained from gas engines. The very best gas engine that has ever been operated on a theoretical basis produced a fuel economy something like thirty-two per cent, total work units or mechanical equivalent from the heat in the coal. The best results produced with highly superheated steam under favorable conditions, I can not say just exactly what the thermal economy is, but they operate at something like twenty-three or twenty-four per cent. The gas engines which actually operate on commercial basis do not run anywhere near the engines which had an efficiency of thirty-two per cent; they run nearly twenty-six or twenty-seven per cent, and while they compare favorably with ordinary engine performances, they are not very much in advance of the best steam turbine performances. Furthermore, the cost of the gas engine is possibly twice the cost of the steam turbine unit. If, however, the steam turbine unit is credited with the possible simplifications which surround it, the difference will be much greater. The steam turbine needs no heavy foundation. A power station for boilers and turbines could be floated on three feet of concrete on any salt meadow, and a like inexpensive structure made to shelter it, and its efficiency be as good as if it were installed in the most expensive station. There will be simplifications in this direction—the ideal turbine station which will be far removed, maybe, from the city, will be laid out more on the lines of a coalyard, or any similar place than on lines where a large and expensive building will be required. On this basis, if we capitalize the difference in fuel consumption between the two engines, it will not cover the first cost. Furthermore, the turbine is ideally simple and the gas engine is very complicated. Every one knows how simple the steam turbine is in a proper state of development. The only experience we have had in this country with steam turbines is with very new steam turbines. The troubles now experienced we think are of a purely temporary character. The steam turbine, as it will be in six months from to-day, can be operated by a child indefinitely, virtually without maintenance. The wear and deterioration is nothing, and the whole plant can be reduced to an ideal condition of simplification. Against this we must consider a gas plant, in which gas must be produced, and in which an immense maintenance

cost goes on in connection with deterioration and renewal of converters and mechanism which must be attended to—the maintenance of engines twice the size of steam engines, twice as complicated, and less perfectly lubricated. The gas engine is a gasoline automobile on a large scale, and perhaps some of you have had experience with those; whereas the steam turbine is as simple as an ordinary grindstone. Naturally every one is interested in the development of the gas engine, and we all realize that some day if coal continues to increase in cost, and gas engines are improved at the same rate that the turbine has been improved, the time will come when fuel economy will be the only consideration and gas engines will come into more extensive use. I think, however, the introduction of a steam turbine is certain to give the gas engine a long setback.

Selenium and a New Form of Photo-Telegraph.

Professor Korn, of Munich, Germany, has devised a new system of photographing by telegraph. This system depends on the property of selenium which has the characteristic of being a poor conductor in the dark, but becoming a good conductor when exposed to the light, the degree of resistance varying according to the amount of illumination to which the selenium is subjected. The apparatus at the sending station consists of a hollow glass cylinder which turns on its axis while moving parallel to the direction of this axis. On this transparent cylinder a photographic negative film is fastened. The rays of light emitted by the source are condensed by a lens on the point of the negative which they traverse and then strike the selenium battery placed in the interior of the cylinder. An electric current passing through the selenium, whose conductivity changes at each instant under the action of the more or less intense light that it receives, passes over the line to the receiving station. At this point the current passes through a D'Arsonval galvanometer with a light aluminum needle to a vacuum tube similar to the Geissler tube, entirely blackened save at the lower extremity, where there is a little aperture situated close above a revolving cylinder covered with a sensitive photographic film. When the galvanometer needle moves under the action of the current transmitted by the line, the curved ends of the needle approach to or recede from a metallic piece which causes currents of high frequency to illumine the interior of the vacuum tube. The light rays escape through the orifice, and the photograph is thus reproduced, point by point, as a positive image.

Improved Governor for Steam Turbines.

A recent British patent to the Hon. C. A. Parsons and James Swinburne describes a device for enabling steam turbines to be run in parallel with one another and for running reciprocating engines in parallel with steam turbines. In steam turbines it is found important for good parallel running that the puffs of steam by which the governing is affected should be coincident in the various units; or in the case of one or more turbines running in parallel with one or more reciprocating engines, the puffs of steam in the turbines should be coincident with the maximum efforts of the cranks of the reciprocating engines. To accomplish this each turbine is supplied with a separate admission valve controlled by a secondary valve actuated by an eccentric. Each turbine is also governed by a separate electric solenoid device having a plunger which acts so as to regulate the length of time during which the main valve is open. All the eccentrics which control the secondary valves are mounted on a common shaft which is driven by an independent motor. This arrangement ensures that the admission valves of all the turbines are open at the same time, although the length of time during which each valve is open is determined by its own governing device. The variations of speed of the driven alternators are thus simultaneous and a steadier running is thereby attained.

Polarization of Roentgen Rays.

In a recent lecture Lord Rayleigh, professor of natural philosophy at the Royal Institution, London, England, announced that M. Blondlot, a French experimenter, had adduced evidence which goes a good way to prove that Rœntgen rays are susceptible to polarization. M. M. Blondlot thinks that the rays are transversal and that they are a species of ordinary light, but of extremely short wave-lengths—perhaps a hundred times shorter than waves of light. Lord Rayleigh has stated that the discovery is of great importance and will help in determining the nature of Rœntgen rays. In the same lecture, Lord Rayleigh, in dealing with the question of illumination, particularly as applied to coast lights, questioned the use of the extreme candle-power employed at some lighthouses. "A single candle," he said, "is visible three miles on a dark night if the air is absolutely clear; but as this condition is hardly ever found, high candle-power is necessary to allow for diffusion." However, he expresses a doubt whether anything is gained by such illumination as is produced by the electric arc at St. Catherines on the Isle of Wight, which is equal to millions of candles. For practical purposes, he thinks 100,000 candle-power is as effective as 30,000,000, and suggests that it would be more valuable to repeat moderate flashlights very frequently than to employ extremely high candle-power permanent lights.

Electric Shock.

In a paper read before the Verein Deutscher Revisionsingenieure, Dr. Kath treated of the conditions for the safety of the men driving electrical plant. Direct current, he pointed out, will, as a rule, become really dangerous only in the case of several unlucky circumstances being present at the same time, as its tension seldom exceeds 500 volts. Direct-current machines should be enclosed tightly, so that sparking, liable to endanger the surrounding medium, is prevented. As regards the properties of the human body, the author draws attention to the fact that an electric shock will essentially act on the nervous system, as the nervous substance is a conductor of electricity surrounded by less conductive fat and muscle substance. The paths most frequently followed by the current in the case of accidents will afford an evidence as to which nerve strings are most likely to be struck, which functions most liable to be paralyzed, as being controlled by these nerves. In the case of the shock entering by a hand or the head and leaving by the other hand or a foot, the nerve descending from the neck and leading to the lungs and heart—the so-called *nervus vagus*—will be struck, and as the latter regulates both the respiration and the action of the heart, respiration will first be stopped, and the action of the heart will eventually cease in the graver cases. A shock entering by the points of the fingers and leaving by the upper arm, however, will, as a rule, not be attended by fatal results, the above nerve not lying on its way. The best assistance in the case of an accident will be rendered in the way of producing artificial respiration, enforcing the heart action and diminishing the pressure of blood, the latter being obtained by injecting one to three drops of amyl nitrate, The dangers of electric currents will, moreover, vary to a high degree according to personal predisposition, persons subject to alcholism, as well as those easily frightened, suffering much more from the effect of electric shock than normal people. The limit of danger is considered as coinciding with 0.1 ampere.

BOOK REVIEWS.

"The Practical Application of the Rœntgen Rays in Therapeutics and Diagnosis." William Allen Pusey, A. M., M. D., professor of dermatology in the University of Illinois; member of the American Dermatological Association; and Eugene Wilson Caldwell, B. S., director of the Edward N. Gibbs X-Ray Laboratory, University and Bellevue Hospital Medical College, New York, member of the Rœntgen Society, of London, associate member of the American Institute of Electrical Engineers. 8vo. pp. 590. W. B. Saunders & Company, Philadelphia, 1903. Supplied by the ELECTRICAL REVIEW at $4.50 in cloth, $5.50 sheep or half morocco.

This book really comprises two distinct but complementary treatises. Part I by Mr. Caldwell, treats of "X-Ray Apparatus and Its Use in Diagnosis." In the introductory chapter is given a brief historical review of the discovery of X-rays; chapters i, ii, iii and iv deal with the construction and manipulation of X-ray apparatus; chapter v, with fluoroscopy; chapters vi and vii, with radiography; and chapter viii, which completes this part, with the choice of an X-ray outfit. Part II, by Professor Pusey, treats of "The Therapeutic Application of X-Rays." Its three first chapters deal with those changes, both gross and minute, which result from exposure of the tissues of the body to X-rays, and with the effects of X-rays on pathologicic tissues and tissue-processes. In chapter iv, the causes of these effects are discussed, and the actinic effects of X-rays are compared with those of light rays. Then follows a chapter on radio-therapeutic technique, one on the treatment of X-ray burns, then on the actual value of X-rays in the treatment of individual diseases and disease-products, and a final chapter summarizing in general terms the present state of radiotherapy. Both parts of the work are preeminently practical treatises —written by men, each of whom has gained by individual observation and experience, as well as by careful study of the literature, an actual finger-end knowledge of the subject, and written for those who wish to acquire such knowledge. Such being the case the reviewer is confident that the value of the book will become more and more evident the more it is used—by which is meant not merely read, but used as a guide in connection with actual X-ray work. The explanations of apparatus and of procedure-methods are simple and concise, yet full enough for practical workers and the theoretical considerations are ample and have been carefully drawn up. The typography and general make-up of the book are excellent, and the 176 illustrations, many of which are photographic reproductions and four of which are beautifully colored plates, are all exquisitely executed. The authors and publishers alike deserve the hearty congratulations of the medical and electrical professions for the production of this valuable handbook, and there is little doubt that it will rank high among standard works on the subject.

"Continuous-Current Dynamos and Motors and Their Control." W. R. Kelsey, B. Sc., A. I. E. E., F. Ph. S., electrical inspector under the Board of Trade to the Taunton Corporation. (Being a series of articles reprinted from the *Practical Engineer* and completed by the author). New York. D. Van Nostrand Company. Cloth. 440 pages. 5¼ by 7⅜ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.50.

The chief merit of this work lies in the fact that it gives in small compass and at a moderate price a general treatment of the essential features of continuous-current dynamo and motor construction and operation. As stated in the title, it is put together in a rather peculiar manner and for this reason it lacks the unity of treatment possessed by some other works in this field. The attempt is made to cover topically the whole subject from the most elementary motions of the magnetic field to the analysis of dynamo and motor operation characteristics and of the intricate subject of commutation. The result is a book which will be helpful to those persons already familiar with the form and general features of direct-current machinery and who wish to know something of its theory. These will probably omit the study of certain pages of theory of commutation and of methods for estimating magnetic leakage, as well as of a number of armature winding diagrams chiefly of interest to designers. There will remain plenty of material of a most beneficial character. There is not enough description of the actual form of modern machines, and it is to be hoped that in a later edition the author will omit the cuts and description of those forms of field magnets and of armature windings not of present-day interest. In their places might be presented a typical modern machine from each class of motors and dynamos. In analyzing the book its material may be divided into three general parts, namely, the elements of electric and magnetic circuits and materials, 85 pages; the design and structural features of continuous-current machines, 226 pages; the operating features of dynamos and motors, 125 pages. The first of these sections contains the conventional matter covering the properties of electrical circuits and of magnetic materials, with the methods for detecting and measuring these. This is clearly expressed in non-mathematical language. In the part devoted to structural features, in accordance with the classification made above, undue space is devoted to armature winding diagrams similar to those found in great profusion in the classic work of Parshall and Hobart. These diagrams, however, are clear and the descriptions enable the reader to follow them well and, to a certain extent, to appreciate the relative merits of the many windings presented. The space devoted to the mounting of conductors upon laminated structures is relatively small, but the subject of commutator construction is fairly well covered. Field magnets are described and illustrated by a lot of obsolete types, mostly two-pole, and too much space, for a book of this nature, is devoted to magnetic leakage. The mechanical matters of shafting, bearings and brush gear are well treated and illustrated. In our opinion the chapter on commutation is out of place in this work, in spite of its excellence as a study of that subject. It is coming to be understood that this is a most intricate matter, and it is doubtful if any considerable number of readers of this work will care or will be able to go into it with the thoroughness which it demands. Hence it would be better to state plainly the difficulties of commutation and in a general way to indicate the plans used for overcoming these. The designer who is interested in commutation from the practical standpoint, and the scientist who studies it to familiarize himself with electrical laws, are the only ones who can be expected to study such a subject, and they will not be likely to refer to elementary works for their information.

What we regard as the best part of the book is that in which the interrelation of speed, torque, current and electromotive force of dynamos is studied. These are matters which interest every one and the author has taken up and clearly illustrated the various characteristics which show these relations. The diagrams are plain and their applications to the control of motors and dynamos are evident. A considerable space is given to the series, constant-potential motor, which is preeminently the machine for traction purposes. This is justified by the general use of electric traction throughout the world. We have no hesitation in commending this work to those students of electrical matters who are already engaged in electrical pursuits or who have access to examples of modern practice in electrical machinery. It is a reference rather than a text-book, for it is not planned from the pedagogical standpoint. The author's ambition, as stated in the introduction, is "that this little book may be the means of directing some practical engineers to that work which is essential to a clear understanding of the applications of electrical energy."

OIL ENGINES FOR ELECTRICAL USE.

BY GEORGE E. WALSH.

The extended use of kerosene oil for generating heat and power has brought the oil engine for special electrical work into prominent use, and the development of the engine to a high degree of efficiency has been noteworthy in the past year or two. One of the greatest advantages of the kerosene oil engine over most other prime movers is that its fuel is so clean and compact that it is easily transported or stowed away in small spaces. One barrel of crude oil weighing about four hundred pounds gives about equivalent results in the engine to a ton of coal. The consumption of oil in the various types of engines varies from half to a full pound per actual or brake-horse-power per hour. Besides having the advantage of a more compact fuel than the steam engine burning coal, the oil engine requires little water for operation.

In plants where the conditions of bulk and weight do not count, the oil is not of much superior advantage; but in isolated regions the oil engine as a prime mover for temporary or permanent electric lighting plants is important. The electric lighting engines are belted to the engines or connected directly. In the latter condition there is a great economy of space obtained. In the arid regions of the West where electric lighting and power are being more generally used than ever before, the oil engines have come to take the place of nearly all other prime movers. Water is a scarce and uncertain article, while coal and other fuel are very costly. The oil can be shipped to those places at less cost than any other known fuel, and without requiring much water can be obtained to run the dynamos.

Of course some water is required, but in the case of the oil engine it is only for cooling the working apparatus, and not for boiler purposes to generate steam. Since the discovery of extensive oil deposits in Texas and California, the price of oil has been greatly reduced, and the cost of operating an oil engine is remarkably low. A good many of the engines are built to-day to use the crude oil without any refining, and in the Southwestern arid regions engines of this type are in special demand. The oil just as it comes from the ground is carried to the engines and immediately burnt without any preliminary improvements. The cost of fuel for this purpose is from one-third to one cent per horse-power-hour.

Kerosene oil engines are constantly in demand for electric light plants in country houses where neatness, compactness and cheapness are demanded. The whole plant is stored away in a small space in the basement of an adjoining house outside where little trouble or expense is incurred. Where the power is transmitted by belt from the oil engine to the dynamo there is a loss of about five per cent, and a great many of the small-house electric lighting plants save this loss by direct-connection. Almost the ideal method of lighting on a small scale has been obtained in this way, and the popularity of the engines and direct-connected dynamos is rapidly increasing.

The portability of the oil engine has opened the way for serviceable electric plants which can easily be shifted. In street work, sewer connecting and tunneling, portable electric lighting plants are quite needful. The use of gas engines designed to burn the city gas, tapped by small pipes running from the gas mains, has enabled contractors to set up portable electric lighting plants with fair success; but the kerosene engine coupled with its own dynamo, either direct or by belt, meets the demands of the case even more satisfactorily. A ten-horse-power electric plant can thus be mounted on its own truck, and contractors can move it several times a day to suit their needs. There is no piping to be made every time the plant is moved, and even the question of storing the fuel is simplified. A barrel of oil can be carted about as easily as the ordinary tools of the workmen.

These portable electric lighting outfits mounted on their own trucks are popular among a wide class of general contractors who must use powerful lights day and night for their work. It has been found possible to work night shifts of men on the streets in this way, where before it was entirely impractical. Likewise in tunnel work, portable electric lighting plants are needed to shift from position to position as the work progresses. There are very few accidents due to kerosene explosions, and this fuel is considered one of the safest yet used for inside work.

Petroleum as a fuel has received special notice in the past year because of the prolonged coal strike and the high prices asked for coal. A great many steam plants were induced to experiment with the fuel, and many of them were installed with grates and furnaces which could use either petroleum or coal. This advantage of being able to turn from one to the other promises to enable manufacturers to save themselves in the future from expensive coal bills through strikes. The ordinary steam plant uses oil fuel only as an auxiliary, and in times when coal soars too high to be used profitably. A number of the large city lighting electric plants were also modified so that either coal or oil could be used.

The danger of burning petroleum freely in manufacturing plants is that the increased demand for it will send the prices above a point where it can be regarded as an economical fuel. Its value is dependent entirely upon inexhaustible supplies of the oil, and consequent low prices. Since the partial exhaustion of the oil supply in Texas prices for oil have steadily advanced, and in the vicinity of coal-beds and mines it is no longer a fuel that can compete with coal. On the seaboard, where the oil is carried in quantities by tank steamers at comparatively little cost, it is still a fuel that can be used sometimes at less expense than coal. In New York petroleum has advanced to over $5 per barrel, which is prohibitive so far as general use for steaming purposes is concerned. In California, however, the cost is only a trifle over fifty cents a barrel, while coal is five or more per ton.

The cost of oil for general steaming purpose is thus a matter dependent upon locality, and consequently its use will never become general except for particular lines of work or as an auxiliary fuel. For small oil engines, for portable electric lighting plants, and for plants where space of storage fuel must count as an important factor, it may always prove a great advantage. Likewise in arid regions, and in localities where pure water for steaming purposes is hard to get, petroleum as a fuel will continue to drive coal and gas out.

In the use of coal, gas and oil for fuel, manufacturers are quick to discover that dependence upon any one to the entire exclusion of all others is unwise, and the tendency is toward the installation of plants with two or more types of engines. It is not uncommon to find in plants and manufactories to-day operated by steam power, small electric lighting and electric power plants run by oil or gas fuel. Oil, gas and coal have combined to make the factories more independent of any one fuel, and with the development of the different types of engines for commercial purposes this tendency will become more manifest. It is only comparatively recently that the manufacturers of gas and oil engines produced engines of large output; but to-day they run up to almost any size needed.

The Association of Edison Illuminating Companies.

Twenty-fourth Convention, Thousand Islands, N. Y., September 8, 9 and 10.

THE twenty-fourth convention of the Association of Edison Illuminating Companies was opened at the Hotel Frontenac, Thousand Islands, on September 8, 1903, by its president, Mr. Louis A. Ferguson.

The following gentlemen were present representing the members and the General Electric Company:

General Electric Company, Schenectady, N. Y.—W. S. Andrews, Frank H. Gale, E. E. Gilbert, Caryl D. Haskins, E. M. Hewlett, engineer switchboard department; H. W. Hillman, J. R. Lovejoy, manager lighting department; J. R. McKee, general manager purchasing and maintenance department; Louis C. Marburg, E. W. Rice, Jr., vice-president General Electric Company; Charles P. Steinmetz, P. D. Waggoner.

The Edison Electric Illuminating Company of Boston—William H. Atkins, general superintendent, Charles L. Edgar, president; Leonard L. Elden, chief electrician; William H. Francis, purchasing agent; R. S. Hale, William P. Hancock, superintendent generating department; Welles E. Holmes, district superintendent; Sidney Hosmer, superintendent of installations; Robert P. Mitchell, manager Milton district; F. Ellwood Smith, district manager; Leon M. Wallace, auditor.

Chicago Edison Company—W. L. Abbott, chief operating engineer; Walter M. Anthony, comptroller; George N. Eastman, engineer; Robert L. Elliott, assistant secretary; Louis A. Ferguson, second vice-president; John Foster Gilchrist, contracting agent; Robert Charles Petyt Holmes, purchasing agent; Samuel Insull, president; Edward William Lloyd, assistant construction superintendent; Ernest Lunn, battery superintendent; Carl Schwartz, electrical engineer.

New York Edison Company—Thomas E. Murray, second vice-president and general manager; J. W. Lieb, Jr., third vice-president and associate general manager; H. M. Edwards, auditor; W. F. Wells, superintendent Waterside station; A. H. Ackerman, engineer meter department.

Edison Electric Light Company of Philadelphia—P. H. Bartlett, superintendent installation; W. C. L. Eglin, electrical engineer; W. H. Johnson, president; A. E. Kennelly, Harvard, Cambridge, Mass. (by permission of Mr. Eglin); H. C. Lucas, purchasing agent; Joseph B. McCall, James T. Maxwell.

The Edison Illuminating Company of Detroit—Alex Dow, vice-president and general manager; Hoyt Post, director and attorney; W. B. Thompson, chief inspector.

Edison Electric Illuminating Company of Brooklyn—W. W. Freeman, secretary; E. A. Leslie, second vice-president and general manager.

The Columbus Edison Company—A. W. Field, secretary; L. G. White, assistant general superintendent.

The New Bedford Gas and Edison Light Company—Charles R. Price, treasurer; George R. Stetson, president and general manager.

General Electric Company, Philadelphia, Pa.—W. J. Buddy, G. L. Thompson, supply department.

Edison Sault Electric Company—William Chandler, vice-president and secretary; J. G. White, constructing engineer.

Potomac Electric Power Company, Washington, D. C.—H. W. Fuller, general manager; E. S. Marlow, treasurer.

The Edison Electric Illuminating Company, Altoona, Pa.—Edgar B. Greene, superintendent.

United Electric Light and Power Company, Baltimore, Md.—P. O. Kielholtz, consulting engineer.

Massachusetts Board of Gas and Electric Light Commissioners, 145 State House, Boston, Mass.—F. E. Barker, chairman.

General Electric Company, Boston, Mass.—Fred M. Kimball, manager small motor department; Sidney B. Paine.

Buffalo General Electric Company—Charles R. Huntley, vice-president and general manager.

Chattanooga Light and Power Company—Byron T. Burt, secretary and general manager.

General Electric Company, Chicago, Ill.—B. E. Sunny.

Erie County Electric Company, Erie, Pa.—Thomas G. O'Dea.

Edison Lamp Works, General Electric Company, Harrison, N. J.—John W. Howell engineer; Francis W. Willcox.

Indianapolis Light and Power Company—Charles C. Perry, secretary and treasurer.

Jackson Light and Power Company, Jackson, Mich.—W. A. Foote, president.

Johnstown Electric Light Company, Johnstown, Pa.—J. W. Reeves, general manager.

Louisville Lighting Company, Louisville, Ky.—A. M. Worthington, manager.

General Electric Company, Lynn, Mass.—F. P. Cox, meter engineer.

Portland General Electric Company—William S. Barstow, 56 Pine street, New York.

General Electric Company, New York—F. C. Bates.

Association Edison Illuminating Companies—Wilson S. Howell, Eightieth street and East End avenue.

General Electric Company, Paris, France—Edgar W. Mix.

Peoria Gas and Electric Company, Peoria, Ill.—R. L. Wallace, superintendent electrical department.

Edison Electric Illuminating Company of Pottsville, Pottsville, Pa.—VanDusen Rickert, secretary and manager.

Rochester Gas and Electric Company, Rochester, N. Y.—George A. Redman, general superintendent electric department.

Rockford Edison Company, Rockford, Ill.—M. A. Beal, manager.

The Seattle Electric Company, Seattle, Wash.—Joseph B. Lukes, superintendent of lighting and power.

Edison Electric Light Company, Schenectady, N. Y.—Henry W. Darling, president.

Schenectady Illuminating Company, Schenectady, N. Y.—A. L. Rohrer.

The Toledo Railway and Light Company, Toledo, Ohio—Ernest J. Bechtel, superintendent lighting.

Edison Electric Illuminating Company of Williamsport, Pa.—Ernest H. Davis, general manager.

Edison Electric Light Company, York, Pa.—J. F. Dusman, general manager.

At the first session, held Tuesday morning, September 8, the reports of the Lamp and Meter committees and of the Committee on National Code were received and discussed.

A paper on "Overhead Pole Line Construction and Operation," by Mr. A. H. Manwaring and Mr. J. T. Hutchings, of Philadelphia, was read.

In this paper Messrs. Manwaring and Hutchings took up the necessary stages in the solution of the problem of current distribution. The old time construction, it is found, was usually light and cheaply erected, and lack of proper maintenance increased the number of accidents, which, together with the unsightly appearance of the poles, strongly agitated public opinion against the entire construction. Various forms of wooden and metal poles were described, and also arrangements of circuits. The methods of fastening and dimensions of cross-arms were illustrated and described, and short chapters were given up to a discussion of braces, pins, insulators, lightning arresters, fuse boxes, location and installation of transformers on the pole line, location and construction of main or trunk lines, grounding of secondaries, and complaints and rules.

At the afternoon session, the report of the Storage Battery Committee was received and discussed, some very interesting information as to the Edison battery being furnished; a paper on the "Selection and Installation of High-Tension Switch Apparatus," by Mr. L. L. Elden, of Boston, was read; and a paper on the "Operating Features of High-Tension Power Stations," by Mr. W. F. Wells, of New York, was read.

The paper by Mr. L. L. Elden, on "The Selection and Installation of High-Tension Switching Apparatus," discussed the development of alternating-current generating and transmitting apparatus, and emphasized the great consideration which is necessary to-day in the designing of the switchboard apparatus. The types of switches which have been developed were detailed and several opinions cited as to the best method of locating the switchboard, the proper bus-bar arrangement, and the distribution of generator switches. Chapters are given to a study of feeder switches, operating means for switches, construction, and general recommendations.

When considering the construction of a switchboard there are several points to be carefully considered before proceeding with the selection of the switching ap-

paratus. The operating requirements should largely govern this selection and on this point it is necessary to decide whether a considerable amount of the responsibility be allowed to rest with the operators, or whether a certain amount of special apparatus be installed with the end in view of rendering the entire installation automatic. The former course is without question the proper one to pursue, as the special apparatus devised to care for unusual occurrences is at times very erratic and unreliable in action, and under some conditions inoperative.

When the reliability of the generating and transforming apparatus now furnished by the manufacturers and the freedom from burn-outs which it enjoys are given full allowance, there is no good reason for complicating the switchboard to avoid an occasional emergency, which may momentarily cause use of the apparatus in excess of its rating.

The emergencies that occur in a well controlled station which can not be cared for safely and properly by a vigilant operator are few and far between, and in general fewer interruptions to the service occur in stations where the switchboards are arranged with simplicity in view and reliable attendants are employed.

On Wednesday, September 9, the session opened with a paper on "Commercial Experience with Nernst and Meridian Lamps," by Mr. W. B. Thompson, of Detroit, the discussion upon which was participated in by Mr. A. J. Wurtz, manager of the Nernst Lamp Company, and others.

Papers were read by Mr. E. W. Lloyd, of Chicago, on "Purchased Electric Power in Factories;" by Mr. Douglass Burnett, of New York, on "The Central Station and the Isolated Plant;" by Mr. Edward A. Leslie, of Brooklyn, on "The Development of Summer Lighting;" and by Mr. Charles Schwartz, of Chicago, on "Comparison of European and American Engineering Practice."

The paper by Mr. E. W. Lloyd, on "Purchased Electric Power in Factories," reviewed the growth of electric power loads in central stations during the past ten years. There is scarcely a doubt but that the connected central station power load in large cities will equal the connected light load at a very early day, as the removal of large isolated plants in office buildings and mercantile houses has increased the power loads of central stations very greatly. The experience of one company demonstrates that in a great number of cases factory plant costs per kilowatt-hour were much in excess of what the central station is able to sell them current for at a profit. Typical installations were described and illustrated and figures given to show the improvement of operation and margin of profit in the use of electric power in factories.

Low power rates are a detriment to central station business as these rates are published by customers from place to place, and often business is lost because the prospective customer hears of an extremely low price in another city, where the local conditions or more often the anxiety of the company to get a power load, prompt them to give a low rate without learning what it actually costs to operate the isolated plant.

Before giving a prospective customer a price per kilowatt-hour, it is well to know what his factory plant costs are. In ascertaining these costs one will probably meet with difficulties.

"The manufacturer with engineering training, or having a mechanical or electrical engineer as manager, thinks he can generate power just as cheaply as we can sell it. We find, however, that a large portion of the customers with whom we ultimately do business, know little of their actual plant costs, and if their estimate of costs is taken, we would find a cost per kilowatt-hour with which it would be impossible for us to compete. A careful investigation of the plant will determine whether their figures are correct."

The paper by Mr. Edward A. Leslie, on "The Development of Summer Lighting," is, in the main, a description of the work of the Edison company in connection with the illumination at Coney Island. Curves were shown, giving the load curve for one of the heaviest days of last December and the load curve for June 27 of the present year.

On Thursday, September 10, the session opened with a paper entitled "Notes on Commercial Features of European Lighting Practice," by Mr. Arthur Williams, of New York. A further discussion was held on the paper by Mr. Charles Schwartz. A paper on "Profitable Advertising," by Mr. Walter H. Johnson, of Philadelphia, was read, as also a written discussion thereof by Mr. J. F. Gilchrist, of Chicago. The discussion on the report of the Meter Committee was concluded.

A further discussion was had on the report of the Storage Battery Committee, which was participated in by Mr. John R. Williams, the second vice-president, and Mr. Charles Blizzard, general sales manager of the Electric Storage Battery Company, and others, which opened the afternoon session. A paper on "Depreciation in Electric Light Plants," by Mr. H. M. Edwards, of New York, was read, as also a supplemental paper by Mr. H. A. Anthony, of Chicago. A most interesting paper on "Results Obtained with Steam Turbines in Milan," by Mr. Guido Semenza, of Milan, Italy, was read, as also a paper on "Steam Turbines," by Mr. August Kruesi, of Schenectady.

At night, a very valuable and interesting "Lecture on Illumination" was given by Dr. Charles P. Steinmetz.

The following officers and members of the executive committee were elected:

President, Mr. J. B. McCall, of Philadelphia.

Vice-president, Mr. C. C. Perry, of Indianapolis.

Secretary, Mr. W. S. Barstow, of Portland, Ore.

Treasurer, Mr. Alex Dow, of Detroit.

Executive Committee—C. L. Edgar, of Boston; Samuel Insull, of Chicago; J. W. Lieb, Jr., of New York; L. A. Ferguson, of Chicago; T. E. Murray, of Brooklyn.

SOCIAL FEATURES OF THE CONVENTION.

A daylight ride on the yacht Idler was made by the ladies on Tuesday morning, and on Wednesday evening an island ramble by searchlight. Golf and bowling contests were also indulged in.

On Tuesday a handicap golf tournament for members was held, Mr. J. B. McCall, of Philadelphia, winning the first prize with the net score of 75, and Mr. J. W. Howell, of Harrison, the second prize with the net score of 77. The prizes for the tournament were kindly donated by the General Electric Company.

On Tuesday evening a progressive card party for the ladies was held, Mrs. J. H. Quine winning the first prize, Mrs. A. L. Rohrer, the second, and Mrs. Samuel Insull, the third.

The croquet tournament for the ladies, which began on Tuesday, was concluded on Wednesday, Miss Alice Anthony winning the first prize and Mrs. C. D. Haskins, the second.

A mixed tournament was played on Wednesday afternoon, which resulted in Mrs. J. R. Lovejoy and Mr. W. H. Johnson winning the first prize by the net score of 87, and Mr. and Mrs. Louis A. Ferguson, the second prize by the net score of 95. The prizes were donated by the General Electric Company.

The Department of Machinery, Louisiana Purchase Exposition, St. Louis, Mo.

There will be installed on the main floor of Machinery Hall, the World's Fair, St. Louis, 1904, engines representing 60,000 horse-power. This exhibit will embrace more horse-power than ever seen at any exposition in this or any other country. There will be utilized in performing various functions of the exposition fully 40,000 horse-power, and the remaining 20,000 horse-power will appear in exhibit form only. More than 200,000 square feet is the area demanded for the 40,000 horse-power employed in the exposition work. The total floor area comprised in Machinery Hall and in the "Steam, Gas and Fuels Building" is equivalent to more than nine acres, and the floor space in Machinery Hall alone has been applied for several times over. All the moving machinery and accessories, condensers and pumps making up the plant will be installed in the westerly half of Machinery Hall. In the easterly section the floor space will be devoted to machine tools, woodworking machinery and fire engines and apparatus.

Thomas M. Moore is the chief of the machinery department. Mr. Moore had charge of the machinery display at the Pan-American Exposition in 1901, and at the close of the Buffalo exposition was called to St. Louis to take charge of the World's Fair machinery department. A number of the items of the power plant are of foreign origin, and these were negotiated for by Lieutenant Godfrey L. Carden, R. C. S., machinery department. Mr. Moore originated the idea that power could be secured for the exhibition on a strictly exhibit basis, and, under his instructions, the manufacturing establishments of the old world were scoured for late types of engines, boilers and other accessories essential for a power plant.

As now arranged the visitor will find on passing into Machinery Hall through the central entrance to the north, in front and slightly to the left, a 5,000-horse-power reciprocating steam engine. This engine and its base have a total height of fifty-four feet; twenty feet of which is depressed below the floor level; the remaining thirty-four feet is elevated above the floor level. Its base occupies a space approximately thirty-five to forty-five feet. The foundations for its support cost $6,000, and its weight with electric generator is over 500 tons. The approximate value of this unit is $150,000. This engine comes from the works of the Allis-Chalmers Company.

Proceeding to the west through the central portion of Machinery Hall the visitor will see in succession the following installations: A 1,750-horse-power gas engine from Tegel, near Berlin, Germany; a 600-horse-power high-speed steam engine from Harrisburg, Pa.; a 750-horse-power medium-speed steam engine from Cincinnati, Ohio; a 1,000-horse-power slow-speed steam engine from Burlington, Iowa; a tangential water-wheel from San Francisco, Cal., operated by water forced through a pipe and nozzle at the rate of 1,200 gallons per minute and under a pressure of 300 pounds per square inch by a steam pump from Jeanesville, Pa. This great volume of water under enormous pressure will strike the buckets of the wheel, transmit its energy and fall as quietly as if poured from an ordinary basin. The water-wheel will make 900 revolutions per minute. Its speed will be regulated by a governor from Boston, Mass., and the flow of water will be measured by a meter from Providence, R. I. Next, to the west, will be found a 3,000-horse-power gas engine from Seraing, Belgium; then an 8,000-horse-power steam turbine from New York; then a 5,000-horse-power steam turbine from Pittsburg Pa., then four 3,000-horse-power reciprocating steam engines, and near to the western end of the central bay this notable line of engines will end with three eighty-horse-power exciter sets.

No one has ever seen such a line of prime movers, yet this is but one of the three lines which will be installed in the western half of Machinery Hall. The line to the north will consist of steam engines, largely of European build and drawn from the greatest works in England, France, Sweden and Germany. The line to the south will, for the main part, be made up of gas and oil engines, the products of the great machine shops of the world. All types, speeds and sizes will be shown, from the little one-half horse-power gas engine for domestic use to the great 8,000-horse-power steam turbine for the operation of lighting plants and trolley railroads.

The Belgian gas engine is also a very wonderful achievement. No one has ever seen a gas engine of anything like 3,000 horse-power. The same builders exhibited at the Paris Exposition of 1900 a gas engine of 600 horse-power, and this excited more interest and comment than any other individual item in that exposition. Here we have one with five times the capacity of the Paris engine. The unit to be installed in this exposition covers a floor space about eighty-five feet long and forty-five feet wide. Its flywheel weighs thirty-four tons, has a diameter of twenty-eight feet and its rim travels at the rate of nearly a mile and three-quarters a minute. A medium sized horse can be driven through its cylinders and its two pistons each travel ten feet at every complete stroke and each makes one hundred strokes per minute. The shipping weight of this engine is approximately 300 tons. About thirty tons of coal per day will be consumed in the generation of the gas to operate it.

At the end of the northerly line of engines and in the northwest corner of Machinery Hall will be found a French reciprocating steam engine of 1,500 horse-power, with its main shaft making 330 revolution per minute, a wonderful speed for so heavy and powerful an engine. Another peculiarity of this installation will appeal to engineers. The French engine is directly coupled to an electric generator built in Paris which operates in parallel an alternating-current arc lighting service with a generator built in Belfort, France, and directly coupled to a tandem-compound steam engine (from Mulhouse, Germany) of 1,000 horse-power and ninety-four revolutions per minute.

One hundred feet to the west of Machinery Hall will be found the "Steam, Gas and Fuels Building" which covers an area of about 100,000 square feet, and is itself an example of the most modern fireproof construction. In this building will be found great hoppers for storing the 4,000 tons reserve supply of coal and mechanical means for automatically conveying this coal from the cars to the bunkers and from the bunkers to the furnaces and gas plants. The daily consumption of coal will exceed 400 tons and the total length of the automatic conveyers lines will be about three-quarters of a mile. Here there will be found boilers to furnish steam and the gas producers to supply the gas for the operation of the engines in Machinery Hall. Briquette making, various types of mechanical stokers, force draft apparatus, water purifiers, and exhibits of items directly germane to the subject of steam generation and control will be installed in this building.

The intermural railway will be operated by four items of the Machinery Hall power plant, and it is interesting to note that the intermural railway consists of a double-track trolley road, standard gauge and standard type of open cars. The

motor equipment and control are furnished by the General Electric Company; the brake equipment and control are furnished as an exhibit by the National Electric Company; the power plant for the operation of the road will be located in the central portion of Machinery Hall, and the prime movers in this plant are as follows:

1. A 1,500 brake-horse-power Oechelhauser system gas engine, 100 revolutions per minute, built and exhibited by A. Borsig, Tegel, Berlin, and supplied with gas from a producer plant built and exhibited by Julius Pintsch, of Berlin.

2. A 900-horse-power Corliss type steam engine, eighty-five revolutions per minute, built and exhibited by the Murray Iron Works Company, of Burlington, Iowa.

3. A 750-horse-power modified Corliss steam engine, 100 revolutions per minute, built and exhibited by the Lane & Bodley Company, of Cincinnati, Ohio.

4. A 600-horse-power four-valve steam engine, 150 revolutions per minute, built and exhibited by the Harrisburg Foundry and Machine Works, Harrisburg, Pa.

The Crocker-Wheeler Company, of Ampere, N. J., built the generators, which in every instance are directly coupled to the prime movers and deliver current at 550 volts at the switchboard.

In connection with the waterways it is interesting to note that the main one consists of a grand basin with lateral lagoons. The water is delivered into this basin from a niche in front of Festival Hall and from fountains in front of two ornate restaurant buildings which flank the Terrace of States. From these three points it flows over cascades and it is to be illuminated by electric lights placed under the lip of each step which breaks the spill. The water is to be lifted by three centrifugal pumps, built and exhibited by the Henry R. Worthington Company. Each pump is planned to deliver 30,000 gallons of water per minute against a total head and suck of 158 feet. Three induction type motors, each of 2,000-horse-power rating, are to operate the pumps. The magnitude of this feature will be better appreciated by those who recall that the total water moved in the Paris Exposition of 1900 was about 4,500 gallons per minute and at the Buffalo Exposition of 1901 about 7,000 gallons per minute, while here in this cascade feature alone we are to move 90,000 gallons per minute. The energy required for the operation of this feature equals the total energy had from the Niagara power plant by the Pan-American Exposition and the total energy availed of for illuminating the Buffalo Exposition. The secondary water system consists of Arrow Head lake. This lake is to afford an opportunity to illustrate the water dwellings and water life of the Philippines. Incidentally, it may be of interest to note that some $600,000 is to be expended on the Philippine exhibit and the result will no doubt be both entertaining and extremely instructive.

Some Data Relative to the Susquehanna River Development.

Work is rapidly progressing on the power plant at York Haven, Pa., on the Susquehanna river, which will distribute current to Baltimore, Philadelphia and other cities in this vicinity. This will be one of the largest hydroelectric developments in the country. The powerhouse is 478 feet long and fifty-one feet wide, in which are forty turbine waterwheels, of 600 horse-power each, two of which operate one 750-kilowatt generator, or a total of twenty generators, together with two turbines of 250 horse-power, each with generators for excitation.

Extending from the building to the falls is a granite wall 3,500 feet long and from twenty-eight to thirty-four feet high. It is six feet at the top and from sixteen to twenty feet at the bottom. The wall encloses a race 500 feet in width and sixteen feet in depth. To construct this wall it has required 100,000 cubic yards of masonry. This large crib dam is thirty by twenty feet wide, varying in proportion in height from eighteen to seven feet, and 3,000 feet long.

Blasting and excavating below the natural surface were done and solid rock reached for the foundations of the powerhouse. A coffer dam 500 feet in length and 240 feet in width was temporarily constructed with 45,000 bags of sand, 250,000 feet of timber and 10,000 cubic yards of stone.

Foreign Students at German Universities.

Of the 37,813 students who are at present matriculated at the twenty-one German universities, 35,082 are Germans and 2,731 foreigners, the latter being 7.2 per cent of the total number. Of these foreigners 2,299 belong to European and 432 to non-European countries. Russia is represented by 860; Austria-Hungary, 536; Switzerland, 253; Great Britain, 149; Bulgaria, 67; Roumania, 63; Greece, 56; Italy, 45; Netherlands and Servia, 45 each; France, 44; Turkey, 36; Sweden and Norway, 32; Luxemburg, 27; Belgium, 14; Spain, 11; Denmark, 10; Portugal, 3; Montenegro, 2; Lichtenstein, 1: America, 276; Asia (mostly from Japan), 133; Africa, 19; and Australia, 5. Of the foreigners, 628 study philosophy, 616 medicine, 588 mathematics and natural sciences, 351 law, 199 forestry, 146 agriculture, 124 Evangelical and 23 Catholic theology, 29 pharmacy, and 27 dentistry; 876 are matriculated at Berlin, 406 at Leipzig, 257 at Munich, 197 at Heidelberg, 146 at Halle, 128 at Freiburg, 99 at Goettingen, 79 at Jena, 75 at Königsberg, 67 at Bonn, 66 at Strassburg, 54 at Würzburg, 53 at Giessen, 51 at Marburg, 41 at Breslau, 37 at Greifswald, 30 at Tuebingen, 25 at Erlangen, 17 at Kiel, 14 at Rostock, and 13 at Münster.

Wind-Driven Generators.

For more than two years two small factories, one near Leipsic, the other near Hamburg, have been satisfactorily driven by windmills, which are also used as a means of generating electricity for lighting purposes. *Elektrotechnischer Anzeiger* states that the windmills have a diameter of five metres and five and one-half metres, respectively, and are mounted on the roof of the works. To ensure reliability the wind-wheel itself has no moving parts, the speed regulation being obtained by turning the windmill so as to vary the angle under which the wind impinges upon the sails, which are built of steel sheets. This is performed by a small auxiliary wind motor, and is said to be done so quickly and accurately that the voltage of the dynamo remains practically constant throughout the range of ordinary wind pressures. An automatic switch cuts out the battery connected in parallel with the dynamo as soon as the wind falls below a certain point. In one of the cases mentioned the battery may be divided into two parallel groups when it is necessary to utilize unusually low winds.

The filament in glow lamps gradually diminishes in diameter in consequence of the slow volatilization of the carbon, says the *Electrician,* London. According to the *Elektrotechnische Rundschau,* a German firm introduces into the glass globe certain chemical compounds with a high boiling point; these, under the influence of the temperature in the lamp bulb, slowly give off vapors containing carbon, which is deposited on the filament, thus making up to a large extent for the loss referred to above, and keeping the resistance and also the brightness of the lamp more uniform throughout its useful life.

THE RIGHT OF WAY.

BY H. H. VREELAND.

Mr. Herbert H. Vreeland, president of the Interurban Street Railway Company, during the recent meeting of the American Street Railway Association, contributed liberally to the discussion, besides offering a paper on "The Right of Way." A part of Mr. Vreeland's discussion follows:

The necessity of approaching questions of this character from the right point of view is very important. Last winter there was a great agitation in New York city on the question of transportation. The existing facilities in the city were clogged and hampered in every way by abnormal conditions of obstruction—the aerial lines by reason of reconstruction and the surface lines by reason of subway construction, and all that went with that; and it was taken up, as a burning question, that proper facilities were not offered to the public. There were two ways to approach that state of affairs: One way was to say that the company was giving all the service it could give and doing the best it could do, and that is all that could be done, which would at once raise a controversy as to whether the company was really doing it or not. There was another way to approach the matter, and that was that the conditions that existed at that time, which surrounded the operation of the cars in the city, were conditions which were apparent to the eye of everybody, but in the rush of business had been lost sight of. It was no new point, nothing novel, absolutely none; every one knew it who saw it every day, and yet when I came out with the statement before a public meeting, that was called on this burning question, that the trouble was not that there was not sufficient service, but that the public was deprived of the use of that service by reason of the obstructions that existed on the tracks and streets, for which the railroad company could not be held responsible, and could do nothing, the matter was viewed in an entirely different way. We elaborated on that point after making a careful study of the general traffic conditions of the city, and went on to show that until there was a recognition on the part of the public authorities that the movement of thousands of citizens should be considered of greater importance than the delivery of a ton of coal or a barrel of flour, the railways were helpless to improve the condition of affairs, the matter was taken up as an almost entirely new proposition. Any number of letters were written to me at that time by persons who rode in the cars of our company on Broadway and who would say that a man with a truck of coal had held the car up for five or ten minutes, and they would all close with saying that the position which the company had taken in the matter was right. The man with the truck load of coal had been running on the tracks for the last twenty years—but the public had become so used to the condition of affairs that it did not exercise enough thought to understand that the true cause of the delay in local transportation was not any fault of the operating company but of the conditions of traffic which existed on the streets of the city and had existed all the while. The agitation resulted in strong public sentiment. The regulation of city vehicular traffic was taken up by the police authorities and by other civic bodies, in the interest of the movement of car traffic, and treated from the standpoint, not of the company, but of the public; that the public were in the cars and that no one lost his right to free movement, etc., by reason of being in a car, and while the car itself might not have the same rights as an individual who was obstructing it in the street, yet the passengers in the cars lost none of their right to free and easy passage through the city streets; that it was a question of the convenience of the few standing aside for the convenience of the many. This agitation resulted in quite a revolution which has had a lasting and improving effect all the time on the question of our transportation, viewed from this standpoint of the right of way.

It seems to me on this question of right of way and other important questions connected with our work, that they are not taken hold of in a strong enough manner; that our side of the question is not put in proper shape before the public in many instances. We are very prone to consider we know it all, and the other fellow does not know anything; that the newspaper man does not know anything when he criticises us; that the citizen who writes a letter of complaint or criticism to the company does not know anything; but we know it all. We make ourselves believe that we are carrying on our particular business better than any one else could do it; and we resent suggestions and criticisms, when we really should study every criticism which is made to see whether we are right or not and get some good out of the criticism to produce a better result. It is the one thing, in my opinion, which has created much of the antagonism that exists in the public mind and in the public press regarding matters connected with the operation of all our systems of transportation, some of the new systems as well as some of the old, the point that we think we know it all. I find when you approach any question from that standpoint that you can create not only a good deal of disturbance in the minds of others, but a good deal of disturbance in connection with the management of the property you have to do with.

I will take up another point which occurred to me as a strong point, and that is the moving of the United States mail. When you consider the rights of the many as against the rights of the few, the United States mail wagon affords one of the strongest examples. A mail wagon leaves the General Post Office in New York to go to the Grand Central Depot. It has mails destined for the Pacific coast, Honolulu, Japan, etc.—nothing local in its character whatever—yet I as a citizen of New York and you as a citizen of New York or any other city, if you happen to be in New York, must stand aside and let that mail wagon go by. The mail wagon and its contents are of no interest to us; add nothing to the comfort or convenience of our lives; there is no mail destined for our office or our houses; we have no interest in it whatever. Yet the consideration of the interests of the world, as a whole, in the movement of its mail matter is such that the consideration of the rights of the millions against the few makes it necessary that you all must go a little to one side and give the mail wagon the freedom of the streets.

We do not ask in our business for the freedom of the street in the operation of our cars, except for the operation of the cars in the interests of the general public and the quick handling of the people who are entrusted in our care. Of course, it is absolutely unnecessary, in view of the many addresses we have had on the subject of what a boon street railways have been to the United States, to go over that old ground again and say why all this should be done, except to leave the statement in this shape—that we should consider this question in a broad way and see if we can not get the general authorities, not only of one state, but of all the states, educated up to that point where they will consider this question from the standpoint of the public itself. Our regulations are just as crude with reference to municipal propositions connected with railway properties, lighting properties, etc., as are many of our rules and regulations with reference to the operation of a property. The conditions have changed so quickly in street railway operation that they have not been met at all by any change in municipal regulations; and when this question was receiving so much consideration in New York city last winter and the matter discussed very thoroughly in the newspapers, the newspaper men were surprised to find that the movement of electric cars with the millions upon millions of passengers transported every year was governed by regulations and laws away back in the sixties and seventies, and it was necessary to collate these and get them in form to present them to the city authorities to get them to see how absurd it was to regulate this vast traffic, or attempt to regulate it, by rules which had been framed for conditions which existed thirty or forty years ago. It was like an experience I had not long ago where, in looking over some questions connected with an accident, in taking up the rules and regulations of a certain company, I found that the rules and regulations were dated in July, 1872, when the property was a horse-car property with less than 100 employés, and operated about twenty cars, and that same property by consolida-

tion had grown into a property employing more than 1,200 men, with a corresponding increase in service and all the operations of the company increased in proportion, and yet the road was operated under rules and regulations dated in 1872, telling how the men should care for the horses, etc., and nothing being said with reference to electric motors.

I am free to say that although there are certain limitations, restrictions and conditions imposed on the operation of street railways abroad, I would be willing to accept these restrictions and limitations and bear whatever loss might ensue, to gain the advantage of having proper regulations of all kinds of street traffic, and have such regulations thoroughly and intelligently enforced, such as exists abroad in the operation of the various transportation systems. The systematic manner in which regulations govern street traffic of all kinds was one of the things which appealed to me very much in looking over the conditions that existed on the other side of the water with reference to operation.

I think that the importance of a proposition of this kind may be minimized in the minds of men who have to do with the operation of lines in the smaller cities and towns; but the importance of matters of this character is emphasized when you consider that a compilation was made last winter of the laws and regulations governing the movement of all street traffic of the United States by the authorities of the city of New York to determine what was reasonable regulation. Some one may consider that this matter is of no interest to him, because of the condition which prevails in his city, where his lines are located; but you must consider these two points: First, that whatever your regulations are, when this question comes up in other sections of the country, your regulations become a part of the consideration of what is being done in other places, large or small, and the next consideration is that some of you bright young men may be operating the lines in the city of New York within the next few years and will have to face this condition yourself. The same thing is true of the franchise proposition, and franchise regulations and limitations and restrictions, which could just as well be included in this general proposition, in my mind. On this point of franchise limitations and conditions, any one who has to do with the operation of properties can not in fairness to the country as a whole consider these things as entirely of locality. To-day enquiry is being made abroad as to what we are doing in this country; and the limitations and restrictions that you may have in a weak moment accepted in securing something for your property may be a keynote and turning point on which hundreds of enterprises abroad may be stranded, and ultimately some in our own country; and without going into a discussion of the details of this matter, from the standpoint of franchise limitations, restrictions and conditions, from the standpoint of vehicular traffic and regulations, and from the standpoint of rules and regulations which govern employés of these properties throughout the country, we can not consider any one of these points as individual, but they must be considered collectively and as a part of the whole number of the railroad properties of the United States, if not of the world.

Report of the Mexico Electric Tramways, Limited.

The report of the Mexico Electric Tramways, Limited, for 1902, presented at the annual meeting of the company, states that the result of the company's operations for the past year, after charging interest on the debentures of the Compañia de Ferrocarriles del Distrito Federal de Mexico, and after payment of the three and one-half per cent guaranteed on the share capital of that company (under the terms of the lease), shows a net profit of the sum of $136,600.04, which, at the rate of exchange of eighteen and one-half pence, gives the sum of £10,529 to be carried forward to the credit of the London profit and loss account. The interest received on the debentures of the Compañia de Ferrocarriles del Distrito Federal de Mexico (held by this company) and the dividend declared by the Compañia de Ferrocarriles del Distrito Federal de Mexico on its share capital (all of which is held by this company) is then added, and after charging expenses and obligations, etc., against the same, a net balance is shown to the credit of profit and loss account of the sum of £20,260. The usual dividend of six per cent has been paid on the preference shares.

During the year under review the company issued 112,987 preference shares, completing the issue of the 500,000 preference shares authorized. One small but important addition to the electric service in the City of Mexico has been made during the past year. The total distance now operated on by electricity, under the company's system, is 116 kilometres. During the year under review 31,132,030 passengers were carried, as against 26,709,225 passengers during the previous year (1901), being an increase of 4,422,805 passengers, and the receipts amounted to $2,400,787.83, as against $2,103,174.87 in 1901, showing an increase of $297,612.96. The increase in prices of material and rise in wages, as a consequence of the lower exchange during the past year as against the previous year, may be taken, at a moderate estimate, at about twenty per cent. Traffic receipts since the beginning of January this year have shown a steady increase, and the receipts for last month reached the encouraging figure of $241,500.

A New Marine Steam Turbine.

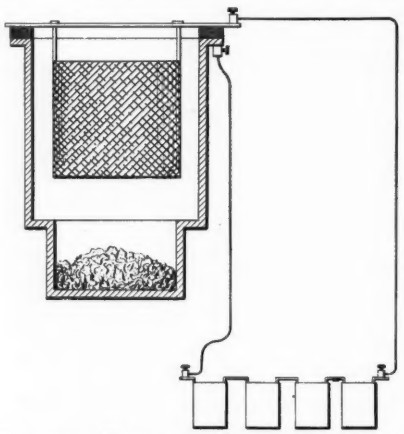
A new form of turbine engine suitable for driving ships has been invented and patented by Mr. John Merson, of England. In this engine the steam passes radially outward through rings or vanes, expanding in its passage, and is finally exhausted into a condenser from the outside of the casing which encloses the vane discs. In the simplest form of construction a cylindrical casing is employed, having vanes on its inner end faces, and a vane disc is mounted within this casing upon a driving shaft which passes through stuffing boxes in the casing ends. Vanes on each side of the vane disc work between the rings of vanes on the casing ends. In this case the latter are stationary and the steam is admitted through a passage into the centre of the casing around the shaft.

In the second form of construction the casing is simply an enclosing chamber with plain walls. In this casing a vane disc is mounted on a central shaft and two facing discs having rings of vanes are arranged to cooperate with the vane disc, one upon each side of the latter. One of the facing vane discs is mounted on a hollow shaft, and the other is connected to the first one beyond the periphery of the central vane disc. Steam is admitted into the hollow shaft and passes into the turbine along the interior of the shaft, being distributed from the central chamber of the turbine through suitably directed passages; and after passing radially through the turbine, it is discharged from the outlet orifice at the outside of the casing. In this turbine there are no stationary vanes. The central vane disc and the two coacting facing discs are driven in opposite directions, the central shaft being thus turned in one direction and the hollow surrounding shaft in the other. Upon each of these two shafts is mounted a propeller, one being right-handed and the other left-handed.

A reverse rotation of the turbine may be produced for backing a ship by a further series of vane rings and fixed vanes on the end walls of the casing between which the outer vanes on the facing discs are adapted to work. Steam is admitted here through suitable side passages and drives the hollow shaft and its propeller backward. In either case the exhaust of the steam from the outside of the casing causes an almost complete vacuum in the other set of vanes which are not in operation, so that there is very little resistance to rotation in the non-working vanes. There is no end thrust in either direction, as the steam acts radially and equally all around the shaft.

Electrical Patents.

Bror A. Bergman, a mechanical engineer, of Nyfors, Sweden, has patented in this country a new method of recovering tin from scraps of tinned iron. The electrolytic processes hitherto employed are all based on introducing the scraps, either compressed or contained in baskets, as the anode into an acid or alkaline electrolyte and by means of an electric current dissolving the tin, and depositing it on the cathode. The disadvantage connected with all these processes lies in the electrolytes soon becoming useless and requiring renewal; the acid baths, owing to dissolution of iron, which causes high tensions accompanied by greater difficulty of dissolving the tin and the depositions of an impure product on the cathode, since basic salts are deposited and iron is also precipitated when the current density increases; the alkaline electrolytes, owing to an increase of stannate of alkali in solution, probably depending on the tin being dissolved as divalent iron, but separated as a tetravalent one, so that the same quality of electricity dissolves more tin at the anode than is precipitated at the cathode, to this being added the action of the carbonic acid of the air in forming carbonate of alkali, which is likewise useless for the solution of the tin. When the percentage of stannate and carbonate of alkali is increased and that of caustic alkali decreased, the tension of the bath rises, oxygen and hydrogen are generated, the tin dissolved with greater difficulty, and the scrap iron being but imperfectly freed from tin becomes useless for smelting into high-grade iron, the electrolyte, moreover, becoming worthless and must be replaced and subsequently regenerated in some suitable manner. Briefly speaking, by anodic dissolution and cathodic precipitation it is impossible whether with acid or alkaline electrolytes to work any length of time, the point being soon reached where the process on the above grounds is spontaneously discontinued. Meantime an increasing amount of electric energy is gradually lost, owing to the secondary reactions appearing and interfering with the process. It has also been tried to arrange the tin scrap as the anode and some more positive metal—for instance, iron—as the cathode in a caustic solution, thereby forming a galvanic pair generating electricity at the same time as the tin was dissolved. This process of dissolving would, however, stop long before all the tin is removed from the iron, a current of electricity from outside sources had to be applied, and the troubles already mentioned were encountered. The consequence has been that at the present state of the art the detinned scrap iron is contaminated with some tin and fetching only a very low price in the market. The present electrolytic process for recovering tin from scraps of tinned iron, is based on an entirely different principle. According to this method, to be sure, tin is dissolved by means of caustic alkali, though in such a manner that a primary battery is formed for transforming the chemical energy developed into electric energy, and the action is strong enough to dissolve every particle of tin. In other

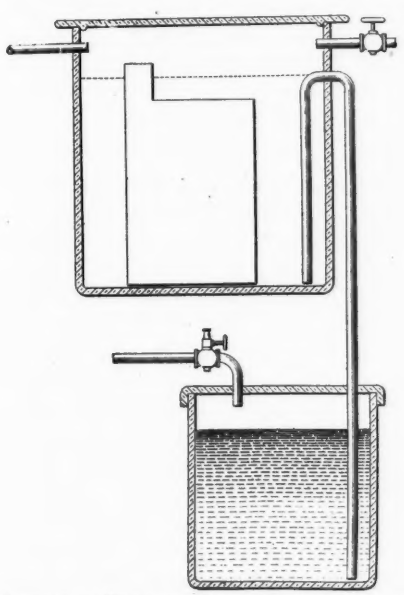


Method of Recovering Tin from Scraps of Tinned Iron.

words, the inventor has succeeded in arranging the apparatus in such a way that the electric energy generated is neither too weak nor too strong. He has accomplished this by introducing a depolarizing compound into the galvanic pair. Depolarizers have long been used in connection with galvanic pairs for the purpose of generating electricity, but the discovery lies in the great beneficial action of using a depolarizer in connection with detinning tin scrap in a caustic solution. The electric energy generated in this manner when the tin is dissolved into stannate of alkali is taken up by and stored in storage batteries connected with the poles of the apparatus in such a manner that the said energy may be used in the final precipitation of the tin or for any other purpose.

The Security Investment Company is the assignee of a patent granted to Charles J. Reed, of Philadelphia, Pa., on a method of treating lead plates for use in secondary batteries. The invention relates to the treatment of lead plates to form active material or material adapted to become active; and it has for its object to provide a method which will effect the formation of the material more expeditiously and of greater depth than is possible by the methods heretofore usually employed. In practising the invention, a metallic-lead plate of suitable form and dimensions is first subjected to the action of a suitable acid in gaseous condition—such, for example, as hydrochloric-acid gas—in a closed chamber or receptacle, preferably in conjunction with an oxidizing agent—such as nitric acid, nitric oxide, nitric peroxide, chlorine, or bromine—thus producing a layer of lead chloride. While it is preferred to employ an oxidizing agent in connection with gaseous hydrochloric acid for converting lead into lead chloride on account of the more rapid conversion thus produced, a less rapid conversion may be effected by the hydrochloric-acid gas alone. In order to form the active material to be utilized in secondary batteries, the lead chloride formed as above specified is reduced to spongy metallic lead either by electrochemical action or by the reducing action of metallic zinc or some other suitable reducing agent. Means for practising the invention are shown in the accompanying drawing, the signal feature of which is a sectional view, partially diagrammatic in character, of the apparatus employed. The closed chamber or receptacle 1 is formed of glass or some other material which is not chemically attacked by the gases and liquids employed in the process, and in the chamber or receptacle is placed a lead plate 2, which, as above indicated, may be of such form and dimensions as will adapt it for use as a secondary-battery electrode. Hydrochloric-acid gas is introduced into the receptacle 1 through a suitable tube or pipe 3 under sufficient pressure to fill the receptacle. This gas attacks the surface of the plate 2 and converts it into lead chloride. In order to make the converting action more rapid, an oxidizing agent—such, for example, as chlorine or one of the higher oxides of nitrogen is used, in conjunction with the hydrochloric-acid gas. The hydrochloric-acid gas may be mixed with the above-mentioned gaseous oxidizing agents before introduction into the chamber or receptacle, or the two gases may be introduced separately. If the amount of gas in the receptacle 1 at any time exceeds what is desired, it may be drawn off through pipe 3*a*. This pipe may also be utilized as an exit for air when the hydrochloric-acid gas is first introduced into the receptacle. The formation of lead chloride is greatly promoted by keeping

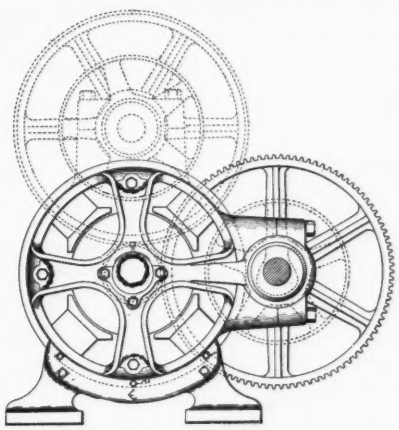
the surface of the lead plate 2 in a moist condition, this condition being brought about either by submerging the plate in water or in a solution containing either hydrochloric acid or nitric acid. If water is employed, it soon becomes a solution of hydrochloric acid by reason of the absorption of a portion of the hydrochloric-acid gas. The intervals between the applications of moistening liquid may vary from two to five hours, according to variations in the operating conditions. For the purpose of supplying water or a solution for moistening the plate 2, a receptacle 4 is shown, containing a solution 5 of a suitable character and connected to the receptacle 1 by means of a siphon-tube 6. The receptacle



METHOD OF TREATING LEAD PLATES USED IN SECONDARY BATTERY.

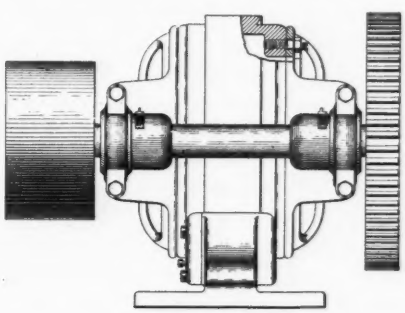
4 may also be provided with a pipe or tube 7, through which compressed air may be introduced into the receptacle. When the air is forced in through the pipe or tube 7, it obviously will force the liquid 5 through the pipe 6 into the receptacle 1, and after a sufficient amount of the liquid has been introduced into the receptacle 1 to moisten the plate 2 the compressed air may be withdrawn from the receptacle 4 through exit-tube and cock 8, and the liquid will then flow from the receptacle 1 into the receptacle 4 by the siphon action.

Norman C. Bassett, of Boston, Mass., has invented an electric motor, and has assigned the patent obtained thereon to the General Electric Company. The invention relates to back-geared motors, in which the armature-shaft carries a pinion meshing with a spur-gear on one end of the counter-shaft, which carries at its other end a belt pulley; the object being to reduce the speed of the belt pulley so that the motor can be used in driving slow-running machinery. The counter-shaft is parallel with the armature-shaft and is journaled in bearings on the frame



ELECTRIC MOTOR.

of the motor. The object of the invention is to provide a construction by means of which the counter-shaft with its spur-gear and belt pulley can be angularly shifted to any one of several positions around the periphery of the motor frame in order to adapt the motor for use in various situations. The field-magnet frame of the motor has a cylindrical periphery concentric with the armature-shaft, which shaft is journaled in bearings in two circular heads. These heads are fitted to rotate on the ends of the magnet frame and are securely clamped against the ends by screw-bolts spaced at equal distances apart on a circle concentric with the shaft. The edges of the heads are faced off to fit against the ends of the frame. On one side of each head there is a bracket or projection forming a journal bearing for the counter-shaft. Suitable caps retain this shaft in place. A separate gear is secured on one end of the counter-shaft and meshes with the pinion on the armature-shaft. The other end of the counter-shaft carries the usual belt pulley and each head carries bearings for the armature shaft, which are provided with oil wells, and furthermore, the bearings have arms by means of which they can be fastened to the head. The wells extend below their respective shafts, so as to give room for a body of oil which is carried to the journal by any suitable device, such as a ring hung thereon and dipping into the oil. When it is desired to change the counter-shaft from one side of the motor to a different position, the bolts are removed and the heads rotated a quarter turn. The bolt-holes in the head and magnet frame now coincide again, so that the bolts can thereupon be replaced. In the same way, the heads can be given another quarter turn to bring the shaft to a position diametrically opposite its original one. Every time the heads are rotated to shift the counter-shaft, the bearings in the armature and counter-shafts must be changed to keep the oil wells below the journals. The magnet frame is provided with legs, which are preferably formed on a saddle in which the frame rests. This frame has a circumferential cylindrical rib with a dovetail groove in the saddle. One side of the groove is formed by a wearing-strip backed by an angular filling-piece, both of which are clamped against the rib by a segment and fastening-screws. The strip and filling-piece can be adjusted for wear by a suitable set-screw. This construction permits the whole motor to be angularly adjusted



ELECTRIC MOTOR.

around the axis of the armature-shaft to occupy positions intermediate those provided for by shifting the counter-shaft or to take up slack in the belt driven by the pulley.

Motor-Cars as Railway Feeders.

One of the new developments on the Great Western Railway which were announced by Lord Cawdor, the chairman of the company, at the recent half-yearly meeting, came into operation on Monday last, when motor-cars were run between Helston and the Lizard. The motor cars have been built by Milnes-Daimler, and are equipped with sixteen horse-power petrol engines. They are capable of seating thirty-two passengers. If this experiment proves successful, other road services will be established as feeders to the railway between the existing stations in country districts. These vehicles will furnish links with the outlying hamlets and small towns needing improved traveling facilities. The scheme is really the outcome of the still more important development which will be inaugurated in October—that of running steam motor cars upon the railway itself, in order to meet the competition of tramway undertakings, which have reduced the company's income from short-distance fares.

Reviews of Current Engineering and Scientific Literature.

Powerful Electromagnets.

New forms of electromagnets have been devised by MM. Camacho and de Mare, and are here described by M. E. Guarini. Camacho's magnet consists of a number of separately wound iron cylinders which slide one into the other. The different windings may be connected up in a variety of ways. When assembled, the various tubes of the electromagnet have the same polarity at corresponding ends. Similar in conception, but of greater power, is the magnet invented by M. de Mare. In this the poles are slotted and concentric coils wound in the various slots. Figures obtained by means of iron filings with an ordinary electromagnet and that of de Mare show a much more even distribution of magnetic lines with the latter, and a table of comparative data is given, showing that with an ordinary wound magnet and one constructed by de Mare, each weighing about one kilogramme and containing equal weights of equal copper wire, for the same amount of electrical energy consumed, the carrying capacity, as measured by the author, was one kilogramme for the ordinary magnet and nine and six-tenths kilogrammes for the de Mare.—*Abstracted from the Electrician. (London), August* 28.

A Process for Manufacturing Tubes of Magnesia with a Coating of Carbon for Use in Incandescent Lamps.

In order to give stability to the carbon filaments of ordinary incandescent lamps, M. de Mare gives them a core of magnesia by means of the following process: He forms a mixture of magnesia, pitch and carbon, with which, under high pressure, he produces filaments, bands, etc., of suitable diameter. These are baked in order to solidify them, and are then incinerated at a high temperature in a gas furnace, after being cut to the desired length. Then an electric current is passed through them while in contact with rarefied air. The carbon contained in the filament is burned, combustion commencing naturally at the exterior and continuing progressively toward the interior, the magnesia forming a solid covering. This treatment is continued until all the carbon is burned and a small cylindrical tube of pure magnesia remains. A hydrocarbon vapor is then admitted to the chamber and this deposits on the magnesia a covering of carbon similar to that obtained by the well-known process of flashing. These filaments have a higher resistance than those of carbon as at present used.—*Translated and abstracted from the Revue de l'Électricité (Berne), August* 15.

Electrometallurgy of Zinc.

A process of producing zinc from its ores has been developed by M. Salgùes. The ore is mixed in a closed electric furnace with an addition of fluxes and proper reducing material such as coke. The mixture is fused, which results in the formation of scoria practically free of zinc. This is drawn off and rejected, and the metal is separated either by pouring or volatilization, according to the conditions of the operation. If it is poured it is recovered under the scorium. If it is volatilized its vapors are collected in the metallic condition in a condenser. The vapors can be burned so as to form zinc-white. Ninety per cent of the zinc can be recovered in this way. It is also possible to treat blende in the same manner without roasting. When the mineral contains lead and sulphur these metals are recovered with the zinc. In 100-kilowatt furnaces the process gives an output of about five kilogrammes per kilowatt-hour. It is thought with specially adapted furnaces that two tons of zinc can be recovered per kilowatt-hour and with a preliminary heating of the materials a much better output will be secured. The process seems applicable to countries where water power is available and coal dear.—*Translated and abstracted from the Revue Pratique de l'Electricite (Paris), August* 20.

On the Asymmetry of a Mercury Break.

In making some experiments to determine the law governing the capacity of the shunted condenser necessary to stop the sparking at the break of an inductive circuit, Mr. James Edward Ives discovered that the necessary capacity varied according to the direction of the current. This phenomenon was so marked that he undertook further experiments to confirm it. The interrupter used when the action was noticed was an ordinary mercury break covered with acidulated water, contact being made with the mercury by means of an amalgamated copper wire. It was found that the action was not due to the acidulated water, nor to the metal of the contact wire, as the reaction took place with and without the water and with iron and platinum wires. It was also found that the effect was not due to the fact that in the ordinary mercury break the spark passes between a point and a plane, for by making a contact between a wire and a thread of mercury in a capillary tube, the same action resulted. It is suggested that the asymmetry may be due to some selective action of the mercury vapor generated when the spark passes, of the same nature as the Cooper Hewitt effect, or it may be due to some capacity effect such as is found in the Wehnelt interrupter.—*Abstracted from the Physical Review (New York), September.*

The Production of High Potentials from Alternating Currents.

The production of high potentials is becoming more and more important in studying many phenomena. Direct-current high potentials are generated by means of special dynamos or storage batteries, but up to this time have been limited to about 40,000 volts. By means of influence machines it is possible to reach 100,000 volts or more, but the current generated is very small. By means of induction coils, spark lengths of one metre and more are reached, yet with this apparatus exact measurements are difficult, because of the inconstant action of the interrupter. The interrupter may be discarded and an alternating current used, and this permits of the calculation of the result if the applied electromotive force follows a sine wave. Herr W. Wien has been working along this line with satisfactory results. In order to avoid the expense of a secondary with a very large number of turns, the turns in the primary coil are reduced; and that the number of turns in the primary may be made quite small, he adopted the plan of increasing the frequency of the applied electromotive force. A special alternator was built for him, giving 1,200 alternations per second at a speed of 2,000 revolutions per minute. This was driven by an eight-horse-power motor, and rated at seven kilowatts with a potential of 220 volts. This machine was connected directly to the primary of an induction apparatus with a spark-gap of forty centimetres, having only forty-three turns of

copper wire of twenty-five square millimetres cross-section in the primary and an ordinary iron core. There was no difficulty in obtaining a strong stream of sparks across a gap thirty-eight centimetres long between two balls, with a primary current of forty-two amperes at forty volts. Much better than this could have been done, but it was not deemed advisable to risk the insulation of the secondary coil.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), August* 1.

Aluminum Conductors for Electric Transmission Lines.

In this article Mr. Alton D. Adams gives a description of a number of important transmission lines in which aluminum is used instead of copper, and then discusses briefly the relative advantages of the two metals. Comparing wires of equal sizes and lengths, the aluminum has only sixty per cent of the conductivity of the copper. Therefore, to secure an equal conductivity, aluminum wire must have a diameter twenty-eight per cent greater than that of copper. Since copper is 3.33 times as heavy as aluminum, for equal weights the latter has 3.33 times the bulk of the former and a conductivity twice as great. The tensile strength of both copper and aluminum wire is about 33,000 pounds per square inch of section, so that for wires of equal length and resistance, the aluminum is sixty-six per cent stronger. Medium hard-drawn copper has a tensile strength of about 45,000 pounds per square inch, so that for equal resistances the aluminum wire still has the advantage. This alone would allow the poles, cross-arms and pins of the transmission line to be lighter or to be spaced further apart, but, on the other hand, the strain due to the wind would be greater with the larger aluminum wire. As the surface of the wire may be no greater than that of the poles, the increased wind strain may not be as great as the increased surface of the wire. Aluminum has a greater coefficient of expansion, and for this reason must be strung with a greater sag, but this greater sag avoids much of the vibration of the wires which is produced by the wind if they are more tightly strung. Aluminum expands between 32 and 212 degrees Fahrenheit about 0.0022 per cent; copper, under the same conditions, 0.0016 per cent. The larger diameter of the aluminum wire over an equivalent of copper has an additional advantage in that the inductance varies inversely to the diameter of the conductor employed, and the silent discharge from wire to wire is also less with larger wires.—*Abstracted from the Engineering Magazine (New York), September.*

A Question in Depreciation.

In every new undertaking the setting aside of an annual sum to cover depreciation of the plant is fit and proper for making an estimate of the returns to be expected, but depreciation should not be accepted as of universal application, as there are numerous occasions when it can not be admitted if a sound commercial estimate is to be made. Consider the case of an independent plant that has already been at work several years, and the future economy of which is to be decided upon. Enquiry need not be made into the early history of the plant or the reasons which led to its installation. It may even be granted that the installation was initially an error and that the economy secured over purchased energy will vanish if the depreciation be deducted. That it has not proved a commercial success matters nothing to the present enquiry, which is whether further working of the plant would pay better than purchasing energy. If the plant would only sell for scrap iron price, it will sell for as much if run for five or ten years more. It is there and can not be unpurchased. Obviously then, if a correct estimate is to be arrived at the plant must be taken as a free gift from a past error, and the future working costs must be calculated without depreciation. When at last the old plant can not be run for the price of purchased energy it should be stopped and sold. If plant would sell at the book value, a mistake could always be cut short by sale of plant; but plant which may be worth book value as a going item becomes scrap very quickly if an attempt is made to sell it. Under such circumstances it becomes justifiable—in fact, commercially correct—to ignore depreciation in a plant which is already at scrap price, though not at scrap value, for the work it may still perform. Another somewhat parallel argument will attach to the evaluation of the work done by a plant and the apportionment of costs. It may occur that a private electric light plant is run in connection with other plant, which can not be dispensed with. In this case, if the lighting plant were stopped the only economy would be the saving in coal, which might be less than the cost of the purchased energy. One can not get away from an accomplished fact and must not, therefore, be tied down by axioms that only properly apply before calculations on paper have been materialized in the form of plant and the money sunk past recovery except by work.—*Abstracted from the Electrical Review (London), August* 28.

The American Electrotherapeutic Association.

The thirteenth annual convention of the American Electrotherapeutic Association will be held at the Hotel Windsor, at Atlantic City, N. J., on September 22, 23 and 24.

Trains leave New York for Atlantic City at short intervals over the Pennsylvania Railroad, West Twenty-third street station.

Atlantic City is a place of great attractiveness for fall conventions, and the natural attractions, in addition to the splendid scientific programme which has been arranged, it is expected, will draw a large gathering to the sessions. There will be morning and afternoon sessions on Tuesday, Wednesday and Thursday. At each of these sessions, the reports of the committees will be heard and papers will be presented and discussed.

Clarence Edward Skinner, M. D., LL. D., is secretary of the American Electrotherapeutic Association, to whom enquiries should be directed.

The Manufacture of Incandescent Lamps.

A concession of great practical utility has recently been granted by the Mexican Government to A. Chaillet, covering the privilege of manufacturing incandescent electric lamps within the Republic. Immense quantities of such lamps are required in Mexico, and as all are imported, it will be readily seen that freight, duty, insurance and breakage, together with merchants and manufacturers' profits, greatly increase the cost of the lamp to the consumer.

The abundant water powers of Mexico furnish a cheap current for electric lighting, and new houses are invariably fitted out with electric equipment.

A company has been formed to take over Mr. Chaillet's patent and concession and to commence the manufacture of the lamps. The capital is $100,000 (Mexican), and the factory will commence with a daily output of 1,000 lamps. As this is less than the demand for the federal district alone, the output will be gradually increased in accordance with the demand.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Wireless Telegraph Apparatus.

There is more interest taken in space telegraphy since its commercial utility has been assured and the practicability of the apparatus perfected than even a visionary person could give credit to.

So clear is the click on the receiver that the messages sent by the operator seldom need repeating, and if both are experts, the messages sent and received are always identical. The future usefulness of the system here described, is stated by the manufacturer to be neither doubtful nor problematical.

The transmitting machine consists of telegraph key, batteries, transmitting transformer, mounted and insulated

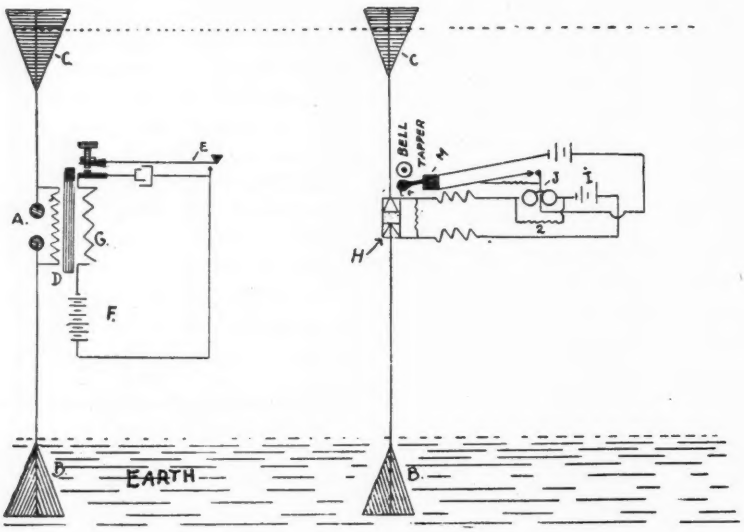


FIG. 1.—SENDING APPARATUS.

FIG. 2.—RECEIVING APPARATUS.

spark-gap, aerial capacity, ground connections and condensers; all assembled, connected and mounted on a highly finished hardwood base, so constructed that the spark-gap coil and key are the only parts exposed to view. The batteries supplying the power to the coil or transformer are placed in the base, totally concealed. All the electrical connections between the coil, key, battery and spark-gap are also connected on the under side of the base, completely concealed. The transmitting coil consists of a high-frequency transformer, specially wound with separable primary and secondary. Very high insulating material is used in its construction. The core is so constructed as to reduce to a minimum eddy currents or core loss. The condensers are treated and insulated with special prepared material, impossible to puncture. The vibrators are made with heavy platinum contacts and so constructed as to remain in constant adjustment. The coil is mounted with polished caps on each end and enclosed with a sheet of highly polished insulating material. The secondaries terminate on each end of the coil at the top of the round polished caps. The vibrators are attached directly to one end of the coil and made fast to one end of the polished cap. At this point the primary current is connected. The telegraph key is placed in the battery circuit and when opened and closed, in making the dots and dashes of the Morse code, which excites the primary of the coil or transformer, causing rapid alternating currents in the secondary, allows a discharge to take place at the spark-gap. The spark-gap is mounted on highly polished insulating pillars, which support the metallic surface, which is made adjustable. At this point, the secondary of the coil is connected and also the capacity connections for attaching to the ground and aerial connections.

The receiving apparatus consists of the following instruments and parts assembled and mounted upon a polished oak or mahogany base.

Adjustable Clark patented sealed coherers, with receiving stand and clips for supporting the coherer and making electrical connections thereby; also special wound split core relay, with one automatic tapper, condensers and shunt coils, batteries in the receiving and tapper circuit.

The batteries, shunt coils, condensers and tapper are all concealed in the base of the receiver case. The relay, coherer and stand, with binding-posts for aerial and ground connections, and the circuit switches, are the only parts visible on top of the base.

The relay is so constructed as to give the best results and is adopted and constructed specially for wireless telegraph work.

The automotic tapper is arranged to work with the least amount of current, guaranteeing high efficiency and long life for the batteries.

The complete arrangement of receiving circuit has been connected electrically in the most simple manner possible, in order to obtain the most practical results.

To communicate between two boundaries, it requires two sets of instruments, *viz.*, transmitter and receiver at each point of transmission and reception, termed stations.

Fig. 1 shows transverse section of the transmitting apparatus and transformer or sender, consisting of a modified form of the Hertz oscillator, the main feature of which is having one sphere of the spark-gap A earthed at B, and the other sphere connected to an elevated aerial capacity or vertical wire C, insulated from the earth, and the two spheres connected to the ends of the secondary winding of the transmitting transformer D.

When the key E is pressed, the current of the battery F is allowed to actuate the coil of the transformer, energizing the primary G and secondary D, which causes rapid succession of sparks to pass across the spark-gap into the vertical wire and earth.

The sudden release, caused by the spark discharge, of the electrical strain created along certain lines of electrical force through space, by the charged wire, causes some of the electrical energy to be thrown off in the form of a displacement wave in the ether, and, as a consequence, the vertical wire or capacity becomes the radiator of electrical waves.

Fig. 2 shows the receiver or responder, consisting of a coherer or adherer H, placed in a circuit containing the local cell I, the special wireless telegraph relay J. The relay is connected to work the secondary circuit, in which is placed

automatic tapper K, also automatic recording tape and writing register M, with the proper shunts (1 and 2), for taking up excessive spark, or self-induction at these points.

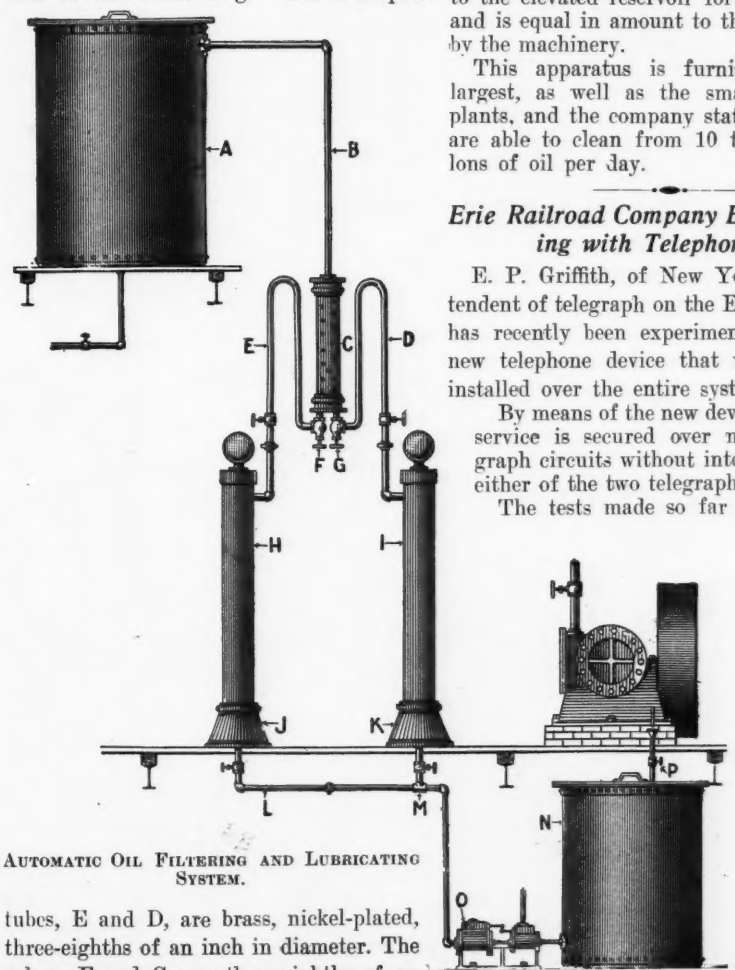
The coherer, or responder, in its normal condition, made up of numerous particles of fine filings or composition, is an imperfect conductor, and offers a very great resistance; the current of the battery can not pass through it, to actuate the instrument, but when influenced by electrical waves, cohesion or adhesion of the particles takes place, the resistance breaks down and it becomes a fairly good conductor, allowing the battery current to flow through, its resistance falling from an infinite value to between 200 and 500 ohms, thus allowing the current from the local battery to energize and work the relay, which in turn causes, automatically, a stronger current to work the tapper and automatic recorder as arranged in the secondary circuit. The decoherer taps the coherer, and in this way restores its high resistance, the results being that the responder is closed for a space of time equal to that during which the key is pressed by the operator at the transmitting station.

The apparatus described above is that manufactured by Thomas E. Clark Wireless Telegraph-Telephone Company, Detroit, Mich. Each transmitter and receiver is enclosed in a neatly finished case, made to hinge in two parts, with nickel trimmings and leather-covered handles, making them just as portable as a suit case. Dimensions of receiver case is seven and five-eighths inches in height, twenty and three-quarters inches in length and eleven inches in width. The transmitter case is twelve inches in height, fourteen and one-half inches long and eleven and one-half inches wide.

Electromagnets promise to come into common use for lifting heavy pieces of iron in factories and rolling mills. Instead of the present hooks and chains a large piece of metal is suspended above the iron or steel object to be fitted, a current is run through this, rendering it magnetic, so that it simply picks up the object and holds it until the current is turned off. A magnet weighing 350 pounds can carry a load of five tons. The time required for fastening a load to a crane by the present methods is estimated to represent one-half the cost of handling the material, so that great saving in handling material is apparent. There is a number of these electromagnets now in use at different steel plants.

An Automatic Oil Filtering and Oiling System.

The Collins Manufacturing Company, Conshohocken, Pa., has placed on the market a new form of automatic pressure oil filtering and oiling system. The operation of this system may be readily understood by referring to the accompanying drawing. The tanks, A and N, are made of galvanized steel and have a capacity of sixty gallons each. The pipe, B, is three-quarters inch brass and nickeled to the elbow. The sight-glass, C, is one and one-half inches in diameter and twelve inches long. The U-shaped



AUTOMATIC OIL FILTERING AND LUBRICATING SYSTEM.

tubes, E and D, are brass, nickel-plated, three-eighths of an inch in diameter. The valves, F and G, are three-eighths of an inch, brass, nickel-plated. The filtering tubes, H and I, are twelve inches in diameter and three feet long, made of steel, electrically welded and enameled. The filtering material filling these tubes is compressed by a screw and disc not shown in the drawing. The piping from the pump is three-quarters of an inch in diameter. The pump is a duplex type and built to pump against high pressure, and is four inches by two inches by four inches.

In this system the oil is supplied to the different cups by gravity from the reservoir, A, situated in a convenient place some distance above the engine. After lubricating the bearings, the oil is carried by the pipe, P, to the tank, N, beneath the engine floor. Through this it is taken by the pump, O, and forced through pipes, M and L, to the tubes, H and I. The two bases, J and K, contain coils which are heated by the exhaust from the pump, O. This thins the oil, which is forced through the tubes, H and I, by a pump pressure of 150 to 200 pounds.

The notable feature of this system is that the oil is visible through the sight-glass, and by means of the valves, F and G, the amount of filtered oil is supplied to the elevated reservoir for distribution, and is equal in amount to that consumed by the machinery.

This apparatus is furnished to the largest, as well as the smallest, power plants, and the company states the filters are able to clean from 10 to 5,000 gallons of oil per day.

Erie Railroad Company Experimenting with Telephones.

E. P. Griffith, of New York, superintendent of telegraph on the Erie Railroad, has recently been experimenting with a new telephone device that will soon be installed over the entire system.

By means of the new device telephone service is secured over metallic telegraph circuits without interfering with either of the two telegraph wires.

The tests made so far have proved thoroughly satisfactory, it is said, and despite the vast amount of noise on the telegraph wires, conversations were easily held and voices even clearly distinguished.

Mr. Griffith states that the new system will be in general operation over the Erie in a short time.

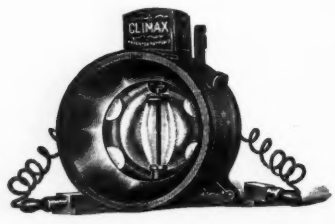
The system is an auxiliary to the telegraph department, and will be of invaluable aid in railroad operation. It may also be used as a safety appliance in case of any possible misunderstanding as to orders.

In all probability the Erie will be the first system in the country to be thoroughly equipped with it.

Combination Arc and Incandescent Headlight.

The Globe Electric Manufacturing Company, Cleveland, Ohio, is manufacturing a new type "Climax" combination arc and incandescent headlight for interurban railway service.

The "Climax" combination headlight



COMBINATION ARC AND INCANDESCENT HEADLIGHT.

is a two-circuit lamp, arc and incandescent. It is simple in construction, neat in appearance and light in weight, making it easy to handle. One of the features of this lamp is that it will operate on a consumption of current from one-half ampere upward, and restores the arc quickly. Each headlight is furnished with two positive plugs, and change of light is made possible by inserting either arc or incandescent positive plugs into the receptacle, or by means of a two-point switch placed in the vestibule of the car.

The lamp has double parabolic reflectors, adjustable bumpers and is made of the best material throughout. The illustration gives a good idea of the neat and simple construction of the lamp.

Stombaugh Guy Anchors.

The proper guying of poles, smoke-stacks, fences, etc., is a problem that confronts the street railway, electric light and telephone managers nearly every day—how to do it best and with the greatest economy. The accompanying illustrations show the Stombaugh guy anchor which is being generally used for this purpose all over the United States and Canada. This device can be installed in from five to fifteen minutes, depending upon the size of anchor and the nature of the ground.

In Fig. 1, Nos. 350, 500 and 600 show the three and one-half, five and six-inch rodless anchor. To use this anchor, a strand is passed through its eye and the hollow shaft of the wrench (shown as Nos. 354, 505 and 606) which is fitted to the keyed portion of the anchor. The anchor is then bored into the ground as a corkscrew into a cork, and always at the angle the guy wire is to run. These anchors are used for light, medium and heavy strains.

Nos. 351R, 502R and 603R show the three and one-half, five and six inch rod anchors which are used by those who prefer not to bury the strand. They are installed the same as the rodless, but with greater ease. These anchors are furnished with rods five-sixteenths inch, three-eighths inch, one-half inch, five-eighths inch and three-quarters inch, japanned or galvanized. The eight, ten and twelve inch (shown as 800, 1,000 and 1,200) are used for very heavy strains, such as corner turns and dead ending, or for guying large smoke-stacks.

FIG. 2.—METHOD OF USING STOMBAUGH GUY ANCHORS.

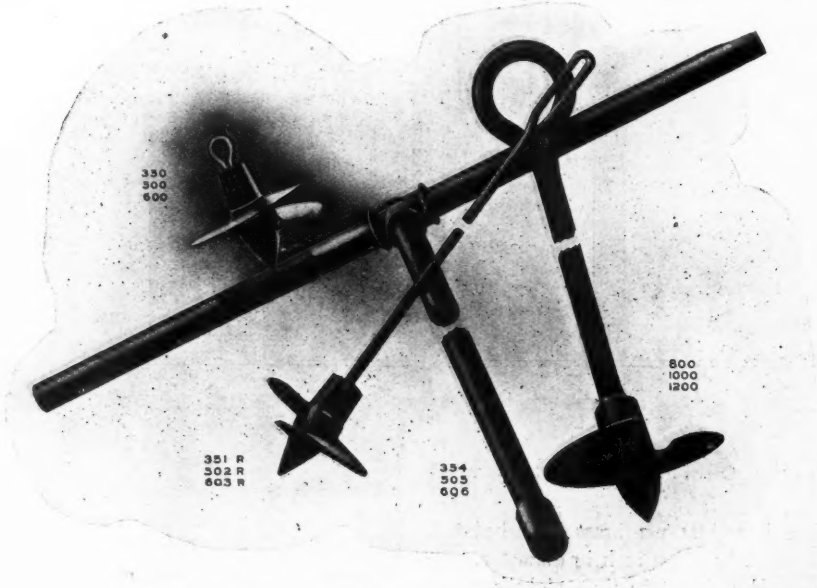


FIG. 1.—VARIOUS FORMS OF STOMBAUGH GUY ANCHORS.

Fig. 2 shows method of using the eight-inch Stombaugh guy anchor for guying poles of the East St. Louis & Suburban Railway Company, East St. Louis, Ill.

Fig. 3 shows a very heavy line of the East St. Louis & Suburbar. Railway Company which is dead-ended with one twelve-inch Stombaugh guy anchor bored in to its full length.

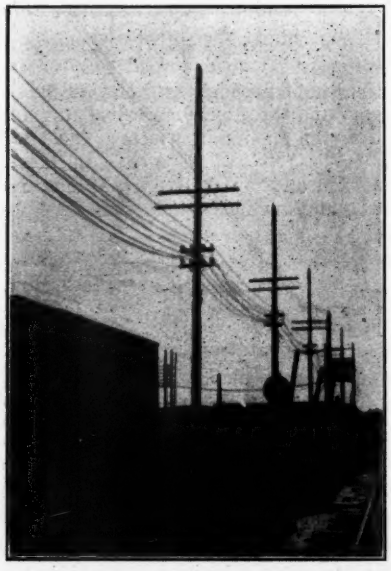


FIG. 3.—HEAVY CONSTRUCTION, EAST ST. LOUIS & SUBURBAN RAILWAY.

The data, and illustrations for this description were obtained through the courtesy of the distributing agents for this device, W. N. Matthews & Bro., 1100 Carleton Building, St. Louis, Mo.

Telephone Apparatus Under Construction.

At the Kellogg Switchboard and Supply Company's factory, Chicago, Ill., the following apparatus is in course of construction:

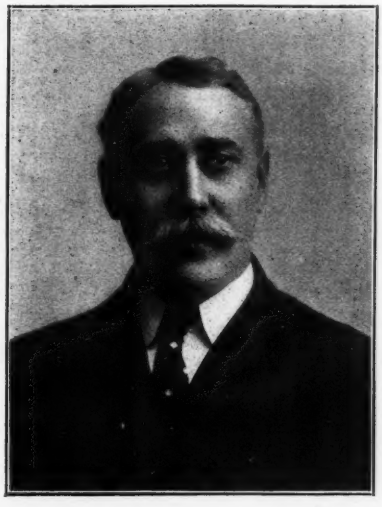
A straight multiple exchange equipment is being made for Cleveland, Ohio, with an immediate equipment for 7,680 lines, in eighteen sections of three positions each, with an ultimate capacity of 18,000 lines. The new Kellogg four-party selective system is to be installed in connection with this exchange, each cord circuit having a four-button indicating ringing key in addition to the regular cord equipment. This switchboard is to replace the old four-division equipment now in use in Cleveland, which was at the time it was installed nearly four times as large as the largest straight multiple board then made. The old Cleveland board is of the local battery type, and it was considered less expensive to install an entirely new equipment than to change it over to work on centralized battery.

Common battery exchanges of the latest type are being constructed for the following cities: Pasadena, Cal., 1,500 lines present equipment, mounted in a framework for 7,200 lines ultimate; McKeesport, Pa., 1,000 lines present equipment, mounted in 3,600-line framework; London, England, for Lavender Hill exchange, National Telephone Company, 800 lines present equipment; Linton, Ind., 800 lines present equipment, with 3,000 lines ultimate; St. Louis, Mo., south office, 2,520 lines present equipment, with 7,200 lines ultimate, requiring at present nine sections of three positions each; St. Louis, east office, 1,080 lines present equipment, with 7,200 lines ultimate, requiring five sections for present installation; Taunton, Mass., 300 lines present equipment, 800 lines ultimate; also four complete common battery switchboards of about four hundred lines present equipment each, for San Bernardino, Long Beach, Santa Ana and Redlands, Cal. These latter have each an ultimate capacity of 1,200 lines.

All the manually operated switchboard equipment to work in conjunction with the automatic exchange at Dayton, Ohio, and Grand Rapids, Mich., is nearly completed at the Kellogg factory. The apparatus for Dayton consists of a multiple tollboard of two sections of two positions each, also a wire chief's desk and a combined trouble clerk and information clerk's desk, each of the latter having two positions, both equipped. The Grand Rapids, Mich., equipment consists of a present equipment of nine two-position sections of multiple tollboard, and one two-position section of rural line board; also a switching section of 12,000 lines capacity equipped for 5,500 lines, and a two-position chief operator's desk, a two-position wire chief's desk and two two-position information clerks' desks.

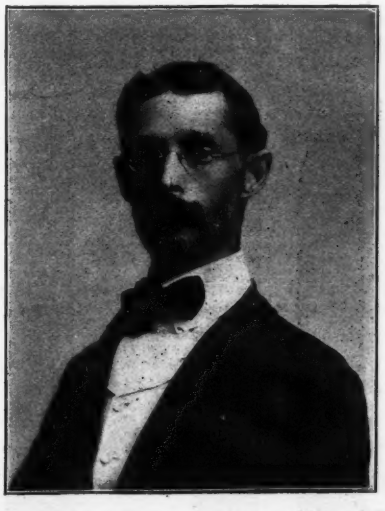
The Lawrence-Hall Electric Company.

The Lawrence-Hall Electric Company is one of the largest commercial institutions of Cincinnati, Ohio, and represents one of the most complete storehouses for electrical supplies in the country. The



MR. F. D. LAWRENCE.

personnel of this company has been long and favorably known to the electrical trade, and the present business is the development and growth of a number of smaller operations, all of which have been ever progressive, and which have led up



MR. WILLIAM ALBERT HALL.

to a modern establishment of considerable worth.

Mr. F. D. Lawrence is president and treasurer of the company, and Mr. William Albert Hall is vice-president and secretary. Originally the business was organized under the name of the Hubbard-Hall Company, changing later on to the Hall Electrical Supply Company; and on March 1, 1903, the name was changed to the Lawrence-Hall Electric Company.

The company deals in a general line of electrical supplies, and is agent for a number of well-known manufacturers of specialties, among which may be mentioned the following: Okonite Company, New York city; Peerless Electric Company, Warren, Ohio; Osburn Flexible Conduit Company, New York city; the Phelps Company, Detroit, Mich.

Mr. F. D. Lawrence was for a number of years manager of the Standard Electric Company, of Cincinnati, Ohio, one of the largest supply houses in the West.

Mr. William Albert Hall has been in the electrical supply business for many years, as his father was an old-time electrician and inventor of a number of electrical appliances now in general use. Mr. Hall has been associated in this manner with electrical interests since early in his career, and his experience has fitted him to conduct such a business as he is now connected with with security and judgment.

Production of Coke in 1902.

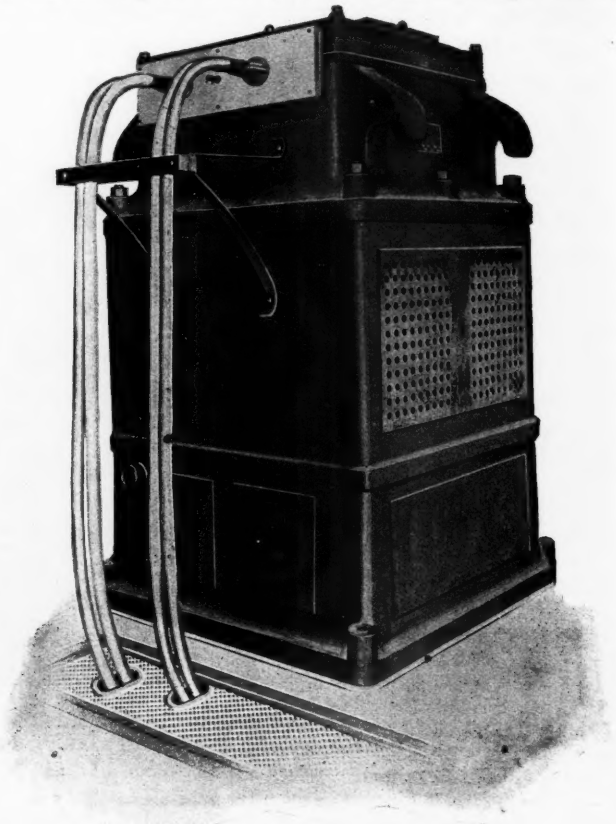
During 1902 there were 69,069 coke ovens in existence in the United States as compared with 63,951 ovens in 1901. Of these 69,069, 67,124 were active and produced an average of 378.4 tons per oven. The total number in 1902 included 1,663 by-product recovery ovens, which produced 1,403,588 tons of coke, an average of 844 tons of coke per oven. The quantity of coal used in 1902 to produce 25,401,730 short tons of coke was 39,604,007 short tons as compared with 34,207,965 short tons used to produce 21,795,883 tons of coke in 1901, an increase of 5,396,042 short tons of coal in 1902 over 1901. The value of the coal consumed increased from $31,378,631 to $39,301,194. In 1901 the value of coal used in making a ton of coke was $1.44 and the average price per ton for the coke produced was $2.04, a difference of sixty cents on each ton. In 1902 the value of coal used in making a ton of coke was $1.54 and the average price per ton of coke was $2.49, a difference of ninety-five cents on each ton of coke. The quantity of coke imported in the United States in 1902 amounted to 140,488 short tons, valued at $423,775, as compared with 72,727 short tons, valued at $266,075, in 1901. The export of coke in 1902 amounted to 439,590 short tons, valued at $1,785,188, as compared with 430,450 short tons, valued at $1,561,898, in 1901.

Air-Blast Transformers.

The accompanying illustrations show the assembly and complete view of Westinghouse air-blast transformers.

Westinghouse transformers of large size are manufactured in two types—oil-insulated and air-blast. The advantages of oil as an insulating medium are so great that the oil-insulated transformer is generally selected for all voltages. The air-blast transformer is, however, made in considerable quantities for those installations where this type is preferred for voltages not exceeding 3,300. The transformers shown in the accompanying illustrations are of the shell type, and their construction provides the same general features as are found in the Westinghouse oil-insulated water-cooled transformers, except that small differences in design and build are introduced where these are required by the change in the cooling medium.

ASSEMBLY OF IRON IN AIR-BLAST TRANSFORMER, SHOWING VENTILATING DUCTS IN THE IRON.



2,750-KILOWATT WESTINGHOUSE AIR-BLAST TRANSFORMER.

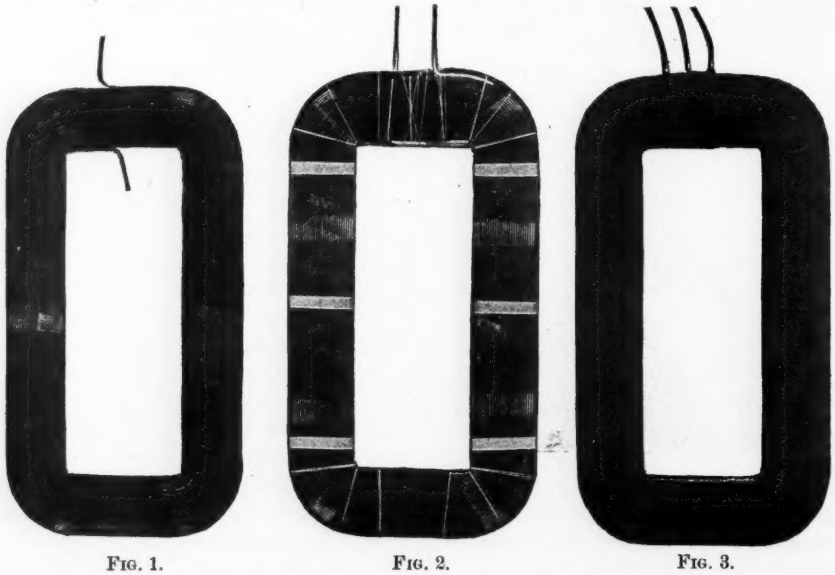


FIG. 1. FIG. 2. FIG. 3.

STEPS IN THE BUILDING OF AN AIR-BLAST TRANSFORMER COIL.

Fig. 1.—Single section of a coil. The wire is rectangular in cross-section and wound on edge.
Fig. 2.—Two single sections assembled to form complete coil.
Fig. 3.—Coil completely insulated with cable leads attached.

The capacity of the standard line of transformers ranges from 100 kilowatts to 3,000 kilowatts, for voltages from 2,200 to 33,000, and for frequencies of 7,200 and 3,000 alternations.

The method of cooling air-blast transformers is by a forced blast of air furnished by a blower. One blower generally supplies a number of transformers in the same station, and the transformers are usually placed above an air-chamber in which a pressure is maintained slightly above that of the surrounding air. The blower may deliver air directly into this chamber, or, if it is more convenient, may be located at a distance from the transformers, feeding into a conduit which leads to the air-chamber. The iron and copper are separately cooled. The air for cooling the coil passes up through the transformers between the coils, which are held apart by spacing strips, and discharges through an opening at the top of the transformer. This opening is provided with a damper for regulating the amount of air passing through the coils. The air for cooling the iron passes from the lower housing through a damper at one side of the transformer, and then horizontally through ventilating ducts spaced at frequent intervals in the iron.

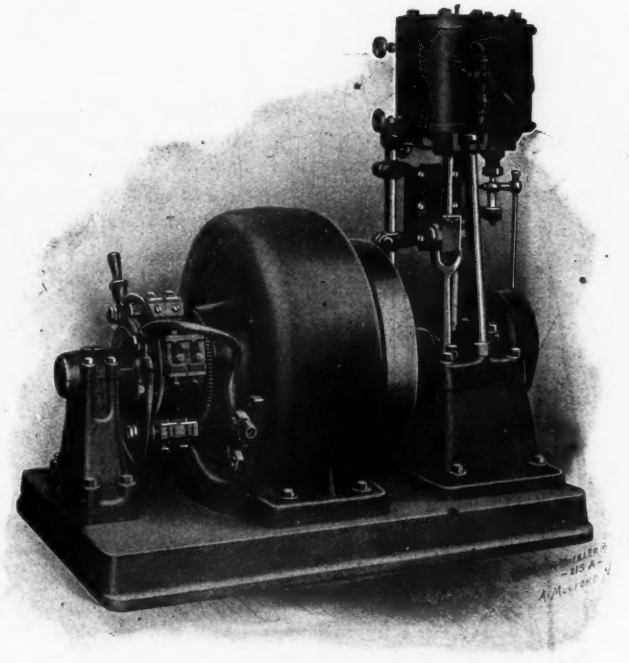
In all transformers, both high and low-

tension windings are divided into a number of flat coils. The high-tension conductor is a flat copper ribbon, wound concentrically with only one turn per layer. The layers are separated from each other by a continuous strip of a specially prepared insulating material, while the coils are insulated individually and are separated by heavy insulating barriers. Where the coil is made in two sections, these are separated by a specially treated shield having a high insulation strength. When completed, the coil is covered by a built-up moisture-proof insulation of great dielectric strength, and a strong mechanical and electrical construction is secured. The same method is employed in winding and insulating low-tension coils.

The air-blast transformers are mounted in a cast-iron housing, and the different parts of the housing are held firmly together by bolts which pass from the upper to the lower casting. These bolts also serve to clamp the iron of the transformer which rests on the lower casting. At each end of the base are panel openings which give access to the low-tension terminals. The low-tension terminals are mounted upon an iron bar (mica insulated) fastened in the lower casting. The high-tension terminals of flexible cable are brought out at the top of the transformer, although both sets of terminals may be brought out at the top or both at the bottom, as may be desired.

A Small Engine-Generator Set.

The demand for a small engine-generator set for marine purposes and use generally where compactness and low first cost are of more importance than low steam consumption and good fuel economy, has opened a most inviting field for just such an outfit as the one shown herewith. It is the outcome of an arrangement effected between the W. D. Forbes Company, of Hoboken, N. J., the builders of the engine, and the Crocker-Wheeler Company, of Ampere, N. J., whose standard open-type multipolar machine is used for the dynamo end of the unit. The set may be had in various sizes, but the particular one illustrated consists of a seven by six-inch simple engine capable of indicating twenty horse-power under 100 pounds of steam when running at 425 revolutions per minute, and a four-pole 20-D type generator having a capacity of eight kilowatts at that speed. Since illuminating is the class of service in which it will meet the most extended use, a more significant conception of its capacity may be conveyed in the statement that it is capable of lighting 140 sixteen-candle-power lamps. Nevertheless, it is remarkable for its lightness and compactness, weighing but 2,800 pounds and measuring in extreme dimensions but fifty-two and five-eighths inches long, thirty-five and one-quarter inches wide and fifty-one and three-quarters inches high.



SMALL ENGINE-GENERATOR SET.

The engine by itself weighs only 475 pounds, this extremely light weight having been secured without sacrificing strength or rigidity by employing scientifically correct lines in the design and the best grade of open-hearth steel for the forgings entering into its construction. The crank-shaft is machined from a solid forging, the crosshead and piston-rod are in one piece and there are no welds permitted in any part. The outfit has been produced with special attention to the refinements essential to satisfactory operation. For example, speed regulation is provided by a "Rites" patent inertia governor guaranteed to maintain within two and one-half per cent of constant speed, this being quite close enough to prevent the annoyance of flickering lights. Contrary to the usual custom, the governor is not combined with the flywheel, as a reference to the illustration will show. This is of advantage, for while the best location of the flywheel is between the engine and generator the governor should be where it is most accessible for adjusting. Although the figure does not show it a gravity system of lubrication is furnished with the engine whereby all moving parts are kept continuously oiled while the engine is running.

The generator is a compound-wound machine of the open type, there being not the slightest objection to its use in a case of this kind, as it may almost invariably be located where dust, moisture, combustible materials, or the usual conditions prevalent when an enclosed type of machine is demanded, do not exist. By virtue of its open construction, on the other hand, it possesses certain advantages not enjoyed by its semi-enclosed or fully enclosed prototypes. Chief among these are the availability of all of its parts for inspection and repair, and the good ventilation afforded to the armature and windings, thus preventing excessive heating even under considerable overload. The entire unit is the result of a most careful design, the component parts are of the highest class of material and the set will be found capable of a steady and reliable service under long periods of continuous full load.

A new electric flashlight has recently been erected on the island of Heligoland by the German Government. The apparatus consists of a revolving parabolic reflector, which is said to give 30,000,000 candle-power. The flashes are a tenth of a second in duration, and succeed each other every five seconds. The light has been observed at a distance of forty miles.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

SPIER'S FALLS POWER PLANT AT WORK—The Hudson River Water Power Company has started the power plant at Spier's Falls, N. Y., and on September 8 began delivering power to the towns of Glens Falls, Saratoga and Ballston for lighting purposes. The company is also delivering power to the Hudson Valley Railway for running cars over fifty miles of the company's road, and is also in a position to deliver 10,000 horse-power to the General Electric Company at Schenectady, N. Y. Three generators of 5,000 horse-power each are now running, and seven more of the same capacity are to be put in operation as soon as possible. The company has contracts to furnish all of the electricity for power and lighting purposes in Troy and Albany.

PROFITABLE MUNICIPAL OWNERSHIP—The report of the Worcester (Mass.) Electric Light Company for the year ending June 30, 1903, is likely to prove an argument in favor of municipal ownership. The Worcester Electric Company paid eighteen per cent dividends on all its stock last year, an increase of ten per cent over the previous year. The company is capitalized at $600,000 of stock distributed among 164 stockholders. The annual report filed recently in Boston shows gross receipts for 1902, $251,910; for 1903, $273,981, an increase in gross receipts of $22,071. Expenses for 1902, $138,821; for 1903, $144,676, making an increase in expenses of $5,855 as against an increase in gross receipts of $22,071, leaving a net increase of $16,217. The dividends for 1902 were $40,000, and for 1903, $108,000.

$1,000,000 MORTGAGE FOR TRACTION LINE—A mortgage for $1,000,000 has been entered by the Savings and Trust Company, of Cleveland, Ohio, for the Mineola, Hempstead & Freeport Traction Company, now the New York & Long Island Traction Company, of Long Island. The loan is for the purpose of constructing, building, equipping and maintaining the traction company's lines and for the purpose of extending these. The company has a trolley road in operation from Mineola to Freeport, L. I., and will soon have the extension from Rockville Centre to the Brooklyn city line finished. A line is also operated to Queens, and new roads are contemplated to Babylon from Freeport, and lines from the north, central and southerly sections of the island into the city of New York, through traffic agreements with other lines, or over the company's own system.

HAWAIIAN ISLANDS ENGINEERING IMPROVEMENTS—It is estimated that very nearly $5,000,000 will be expended in connection with improvements at Pearl harbor, Hawaiian Islands. Three artesian wells are to be drilled, costing some $18,000. A pumping plant will entail an expenditure of $50,000, and a water-pipe system and stand-pipe are expected to cost $40,000. The same amount is to be spent in a sewerage system. Storehouses to cost $150,000 will be built, and a machine shop will be erected which will cost $150,000 for construction and equipment. A foundry will be put up at a cost of $50,000, and a yard and docks built and equipped, costing $150,000. The same sum will be spent on the construction of two wharves, and $100,000 is appropriated for dredging. An electric plant is planned, for which $150,000 is appropriated. For the purchase of tools and appliances $45,000 will be laid aside. Railroad and rolling stock will cost $100,000. The construction of the drydocks is calculated to cost $3,250,000.

AN EXTENSIVE INTERSTATE TROLLEY SYSTEM—Plans are under way for a continuous system of trolleys from Columbus, Ohio, to Pittsburg, Pa., or from Pittsburg to Indianapolis, Ind., through Columbus. A road has recently been opened from Pittsburg to Wheeling, W. Va., and a contemplated extension to Bellaire, Ohio, is the beginning of the line connecting the cities above named. The line from Indianapolis, Ind., to Bellaire, Ohio, will be 364 miles long, and from Indianapolis to Newark, about 226 miles. The road includes Columbus and Springfield on the line, as well as Dayton. A link is to be built from Newark to Zanesville, from which point a road runs to Bellaire and to Wheeling. From Wheeling the Ohio Valley Traction Company has a road of nineteen miles in operation to Wellsburg, W. Va. A grant has been allowed this company to construct a bridge across the Ohio River at Wellsburg, to connect with Brilliant, Ohio, the terminus of the Steubenville-Mingo Electric Railway, which has had a line in operation for some time to Toronto, Ohio. Rights of way have been obtained and the survey is nearing completion for the construction of a road from Toronto to Wellsville, the terminus of the East Liverpool Street Railway, which operates to Smith's Ferry, Pa., four miles east of East Liverpool. From Smith's Ferry a survey has been completed for a road to connect with the Beaver Valley Traction lines at Vanport, Pa., which extends east, following the Ohio river beyond Rochester and Monaca. Rights of way have been secured and surveys completed by Cleveland, Pittsburg and New York capitalists for the construction of a road from Rochester to Avalon, Pa., where connections are to be made with the lines of the Pittsburg Railway Company, which has branches extending as far east as McKeesport and Wilmerding, Pa.

ELECTRIC LIGHTING.

OAKLAND, CAL.—The Suburban Lighting Company will extend its system to Fruitvale, to light the city streets.

FORSYTH, MONT.—The new electric light plant which is being established here will be in operation within ninety days.

MANKATA, MINN.—Welcome has voted to bond the village to the extent of $9,000 for a lighting plant and waterworks.

BARNESVILLE, GA.—The city council has accepted the bids for the new electric light plant and work will begin at once.

SPRINGFIELD, ILL.—Work has been commenced on the building of a large addition to the plant of the Sangamo Electric Company.

WHITHALL, ILL.—The electric light plant at Roodhouse has been purchased by C. W. Payne, of Roodhouse, and W. J. Kreider, of Jacksonville.

BELFAST, ME.—The plant of the Belfast Light and Power Company has been sold to M. Curtis Fletcher, of Boston, at the reported price of $30,000.

BENTON, WIS.—The board of trustees has let the contract for the electric light plant to David Morrow, of Galena. Work is to be completed by November 1.

DECATUR, ILL.—The main power plant for the Decatur, Springfield & St. Louis Interurban Railroad will be built at Riverton, near Springfield, at a cost of $250,000.

JOHNSTOWN, PA.—The new Rockwood Electric Company, which has a contract to furnish street lights for that town, is rapidly completing its plant, as it must be in operation by November 15.

BAY CITY, MICH.—It is learned that the Saginaw-Bay City Railway and Light Company has purchased land in Saginaw and will erect a power-house to supply the Saginaw and Bay City lines.

HOLLY, N. Y.—The Albion Power Company has purchased from George F. Lum his mill property and water rights at Clark's Mills, east of Waterport. This purchase gives the company an additional water power equal to that at Waterport.

MIDDLETOWN, N. Y.—The city has awarded a contract to the Consumers' Light and Power Company to light the streets for one year from November 1. The company's bid was $5,827.50, or $47.50 for arc lights and $9 for incandescent lights, additional lights to be furnished at the same rate.

NYACK, N. Y.—A proposition to appropriate $21,000 for a municipal lighting plant at North Tarrytown was voted down at a special election of the taxpayers. The argument against the proposition was that the village was too small to maintain such a plant, and that it would be lighted more economically by a private cor-

poration which lights the other towns and cities of Westchester County.

GLOVERSVILLE, N. Y.—At the regular meeting of the board of trustees of the village of Fonda, the application of the Edison Electric Light and Power Company to set poles and string wires through the town was granted. The company will have the work completed by the middle of October.

FAYETTEVILLE, W. VA.—The Fayetteville town council, at a special meeting, granted E. W. Becker and associates a twenty-five-year franchise to erect and maintain an electric light and power plant within the corporate limits of the town. The company states that it will install a very complete plant.

PORTAGE, PA.—The Portage Light, Heat and Power Company, which is being promoted by H. A. Tompkins, P. F. Campbell, H. D. Hoover and J. J. McDonnell, has applied for a charter. The company will supply current to this city and to the neighboring communities, including Wilmore, Puritan, Cassandra and Jamestown.

ST. PAUL, MINN.—The electric franchise granted two years ago to F. B. Brace, G. H. Shellenberger and F. G. Genge, has been transferred to the Union Manufacturing Company. The company, which was incorporated to take over the franchise, will furnish power to factories in St. Anthony Park and light for two wards of the city.

KNOXVILLE, TENN.—The Knoxville Power Company is preparing to begin work on its dam on the Little Tennessee, in the mountains of Blount County. The company plans to generate electricity which will be sold to local manufacturing industries throughout this section. Its capital stock is $500,000, and those prominent in connection with it are General John T. Wilder and Marshal R. W. Austin.

FLINT, MICH.—The formal organization of the Flint Light and Power Company has been effected, with D. C. Wright, president, and A. G. Bishop, as secretary-treasurer. The board of directors is composed of J. J. Hurley, W. A. Paterson, Alexander McFarlan, D. C. Wright, of Flint, M. A. Brown, E. R. Knauss, of Philadelphia, E. R. Snyder, of Allentown, Pa., and J. H. Baker, of Buffalo, N. Y. The capital stock will be increased to $150,000.

DETROIT, MICH.—At the meeting of the public lighting commission, the annual report for the fiscal year ending June 30, 1903, showed that the cost of operation and maintenance had increased $21,320.35 over that of the previous year, an increase of 21.50 per cent. The increase is said to be directly due to the coal famine of last year and also to the present advance in wages. The total cost of maintenance and operation was $120,408.01, as against $99,087.16 last year. The total number of arc lamps supplied was 2,386, as compared with 2,133 the previous year.

MINEOLA, L. I.—Incorporation papers have been filed in the county clerk's office for the New York & Long Island Gas Company. The company purposes to supply electricity and gas for lighting streets, public and private buildings, etc., in cities, villages and towns throughout New York state, including the whole of Long Island, naming the towns of Hempstead, North Hempstead and Oyster Bay, in Nassau County; the villages of East Rockaway, Freeport, Rockville Centre, Lawrence and Sea Cliff, in the said county; the towns and villages of Brookhaven, Babylon, East-Hampton, Huntington, Islip, Riverhead, Shelter Island, Smithtown, Southold, Amityville, Greenport, Northport, Patchogue, Southampton and Sag Harbor, in Suffolk; the borough of Queens, city of New York; the county of Queens, the borough of Brooklyn, city of New York, and the county of Kings. The directors named for the first year are John B. Summerfield, of Arverne; Eben Jackson, of Manhattan, and Seymour K. Miller, of Brooklyn.

ELECTRICAL SECURITIES.

Although there was a more favorable report regarding the crop condition than was expected, the market did not show any inclination to rally, and the week closed with little improvement as far as activity in speculation was concerned. There is still a tendency in many quarters to look askance at even good opportunities for investment, due to the apprehension caused by the long slump in the market. On the other hand, the ability of financial interests to weather a long period of depression such as has been passed through recently has engendered a feeling of hopefulness in the stability of securities in general that works for sluggishness under conditions which at another time would cause the most apprehensive anxiety. Now that there is every opportunity for monetary relief, due to the $40,000,000 fund held by the Treasury Department, the opinion is gaining ground that it will not be necessary to touch any of this.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 12.

New York:	*Closing.*
Brooklyn Rapid Transit	40½
Consolidated Gas	173¾
General Electric	162½
Kings County Electric	150
Manhattan Elevated	134¼
Metropolitan Street Railway	114¼
New York & New Jersey Telephone	148
Westinghouse Manufacturing Company	170

A quarterly dividend of one and one-half per cent on the capital stock of the Manhattan Railway Company will be paid on and after October 1, 1903, to stockholders of record at the closing of the transfer books on Friday, September 11, at 3 P. M. The transfer books will reopen on Wednesday, September 23, at 10 A. M.

The board of directors of the Western Union Telegraph Company has declared a quarterly dividend of one and one-quarter per cent upon the capital stock of the company, payable at the office of the treasurer on and after the fifteenth day of October next to shareholders of record at the close of the transfer books on the nineteenth day of September instant. For the purpose of the annual meeting of stockholders, to be held October 14, and of the dividend mentioned, the stock books will be closed at three o'clock on the afternoon of September 19 and be reopened on the morning of October 16.

The balance sheet of the Consolidated Gas Company as of June 30, 1903, shows assets of $102,518,945 and liabilities of $87,254,875, leaving a surplus of $15,264,070, as compared with a surplus of $14,095,754 on January 31, 1901. The company has been granted permission by the New York Stock Exchange to list $519,000 additional capital stock, making the total amount listed $73,437,500.

Additional assenting stock of the Westinghouse Electric and Manufacturing Company to the amount of $4,500,000 has been listed on the New York Stock Exchange, making the total amount listed $18,526,800.

A dividend of $2 per share will be paid on October 15, 1903, to holders of the stock of the General Electric Company of record at the close of business hours on Wednesday, September 16, 1903.

Boston:	*Closing.*
American Telephone and Telegraph	132½
Edison Electric Illuminating	230
Massachusetts Electric	78½
New England Telephone	124
Western Telephone and Telegraph preferred	80

Philadelphia:	*Closing.*
Electric Company of America	8½
Electric Storage Battery common	55
Electric Storage Battery preferred	55
Philadelphia Electric	6⅛
Union Traction	43⅞
United Gas Improvement	84

A dividend of 2 per cent has been declared on the stock of the United Gas Improvement Company, payable October 15. Books will close September 30 and reopen October 16.

Chicago:	*Closing.*
Chicago Telephone	122
Chicago Edison Light	145
Metropolitan Elevated preferred	55½
National Carbon common	20
National Carbon preferred	89¾
Union Traction common	5
Union Traction preferred	32

It is stated that the Chicago Telephone Company now has in use a total of 94,025 instruments, being a gain for the year ended September 1 of 24,814.

The month of August completed the first half of the Metropolitan Elevated Company's fiscal year. The gross receipts amounted to $1,006,981, an increase of $56,022 or five per cent over the similar period in 1902.

LEGAL NOTE.

TELEPHONE "MISCONNECTIONS" AND THE LAW—The following is an interesting study on this subject, as *Case and Comment* sees it: A suit against a telephone company for the failure of a telephone to work when needed to call the fire department, in consequence of which serious damage was done by the fire that might have been prevented if the telephone had been in working order, has just been brought in Rochester, N. Y. This is probably the first suit of the kind on record. The defence is that a clause in the contract under which the telephone was placed in the building exempts the company from "all risks for misconnections, mistakes, or errors in receiving, transmitting, or delivering messages." The failure of the telephone to work is alleged, however, to be due to negligence in installing the instrument, or, rather, in the connection or joinder of the wires outside of the house, so that the ends did not remain in contact. The plaintiff claims that this negligence in connecting or joining the wires is not one of the "misconnections" referred to in the clause quoted. The question, therefore, seems to be merely one of the construction of the contract. It is, moreover, a narrow question, which is of general interest chiefly because the matter of liability of telephone companies for defects in their wires or instruments is altogether a new subject. The validity of such an exemption of the telephone company from liability can hardly be open to question—at least in the state of New York. As the courts of that state uphold express contracts, even by common carriers, to limit their liability for negligence, there can be no hope that they would hold that such a stipulation by a telephone company is not valid. The question might be somewhat less hopeless in the numerous jurisdictions which deny the validity of such stipulations by common carriers, on grounds of public policy. But that rule is clearly an exception to the general rule which permits parties to contract as they choose for exemption from liability, and even in case of railroad companies the courts have refused to extend the rule applicable to common carriers, beyond the limit of their business as carriers. In Stephen *vs.* Southern P. Co. (Cal.) 29 L. R. A. 751, in Hartford F. Ins. Co. *vs.* Chicago M. & St. P. R. Co. 30 L. R. A. 703, 70 Fed. 201, and in some other cases a stipulation by a railroad company against liability for damages to buildings of a lessee on railroad land, even if caused by the railroad company's negligence, has been sustained. On the other hand, the rule applicable to common carriers will necessarily be applied not only to telegraph, but also to telephone, companies in states where such companies are held to be common carriers. That a telegraph company is a common carrier has been held in Western U. Teleg. Co. *vs.* Call Pub. Co. (Neb.) 27 L. R. A. 622; and there are direct decisions against the validity of a stipulation for exemption from liability for negligence by such companies, in Brown *vs.* Postal Teleg. Cable Co. (N. C.) 17 L. R. A. 648, and in Gillis *vs.* Western U. Teleg. Co. (Vt.) 4 L. R. A. 611, and in some other cases. That a telephone company is a common carrier is decided in State *ex rel.* Gwynn *vs.* Citizens' Teleph. Co. (S. C.) 55 L. R. A. 139, and Nebraska Teleph. Co. *vs.* State *ex rel.* Yeiser (Neb.) 45 L. R. A. 113, but those cases did not expressly decide as to the exemption of such companies from liability for negligence. Wherever such companies are held to be common carriers the courts will doubtless apply the same rule with respect to liability for negligence that they apply in case of other common carriers.

TELEPHONE AND TELEGRAPH.

SAN DIEGO, CAL.—An independent service is to be established between San Diego and Escondido.

SENECA FALLS, N. Y.—The Home Telephone Company has decided to erect its line to Bridgeport.

CHATTANOOGA, TENN.—The Hamilton County Telephone and Power Company has been organized.

SYRACUSE, N. Y.—The Postal Telegraph Company is putting a new line through from Syracuse to Oswego.

YORK, PA.—The Cumberland Valley Railroad is constructing a telegraph line from Martinsburg to Winchester.

SALT LAKE CITY, UTAH—The Utah Independent Telephone Company will put its wires underground in the business district.

BLOOMSBURG, PA.—The Columbia County Telephone Company has been organized to build an independent telephone system in this county.

SPRINGFIELD, MASS.—The selectmen have voted to allow the Southern Berkshire Independent Telephone Company to locate poles and wires in the town.

CANANDAIGUA, N. Y.—The Interlake Telephone Company is now connected with the Gorham, Stanley, Rushville and Hall's Corners line, and also with Penn Yan.

GAS CITY, IND.—Work on the rural line of the Central Union Telephone Company, between Gas City and Upland, has been commenced, and it is hoped to have it in operation before cold weather sets in.

HOUSTON, TEX.—The city council of Seguin, Tex., has granted a franchise to the Commercial Telephone Company to erect a system of poles, wires, etc., and to conduct a telephone business in the city.

WILMINGTON, N. C.—The Inter-State Telephone Company will make extensive improvements to its system in this city beginning next month. The city will be asked for permission to place all wires underground.

TOLEDO, OHIO—The Toledo Home Telephone Company has reported a great increase in business in the last year, it has increased the number of telephones which are in use from approximately 2,500 to 7,300.

MIDDLETOWN, N. Y.—At the annual meeting of the stockholders of the Monticello Telephone Company, the following officers were elected: John D. Lyons, president; A. A. Crain, vice-president; H. F. Hilmes, secretary; George L. Hatch, treasurer.

LINCOLN, NEB.—The Beaver Crossing Telephone Company has changed its name to the Seward County Telephone Company. It has a capital of $50,000, and the incorporators are C. W. Doty, H. C. Johnson, J. P. Mayhew, Harry Coke and W. J. Organ.

NEW YORK, N. Y.—It is announced that the Police Department of New York city has contracted with the New York Telephone Company for an exclusive telephone system. The present plan calls for 661 telephones, and the expense will be between $400,000 and $500,000.

BELOIT, KAN.—The Solomon Valley Telephone Company, which succeeded W. W. Dilworth, the proprietor of the Beloit Telephone Company, now has in operation exchanges at Cawker City and Glasco, as well as toll lines reaching from Beloit and Downs to Glasco and Scottsville.

BALTIMORE, MD.—A new suburban telephone station will be established by the Maryland Telephone and Telegraph Company at Forest Park. This station will be opened to take care of the business of that company at Forest Park, Walbrook and Arlington. About $20,000 will be expended in erecting this new station.

SPRINGFIELD, OHIO—The Morning Sun Telephone Company, of Morning Sun, Preble County, Ohio, has been incorporated with a capital of $10,000, by R. H. Douglass, U. M. Cook, J. R. McCreary, S. M. Paxton and S. C. Weed. It will operate lines from Morning Sun to Oxford, Fairhaven, College Corner, Eaton and Camden.

KEOKUK, IOWA—Articles of incorporation have been filed by the Union Telephone and Telegraph Company, with its principal place of business in this city. The incorporators of the company are J. C. Hubinger, Alfred Stromberg, P. C. Burns, C. W. Stiher, Charles W. Farr, E. W. Hurst, E. B. Overshiner, Charles Messer and Henry Shafer.

HETLAND, S. D.—Work has begun on a new rural telephone line which will connect with the system at this place. The line will extend in a northwesterly direction. It is also proposed to run another line southwest from the town to be completed this fall. It will connect with a line which runs in a southeasterly direction from Lake Preston.

CONNELLSVILLE, PA.—It is announced that the Tri-State Telephone Company will build an independent line from this section to Pittsburg, and that work will be commenced in a short time. The company is also preparing to make connections with the Maryland, West Virginia & Pennsylvania Telephone Company, which will give Fayette County connections with all the towns between here and beyond Cumberland.

ELECTRIC RAILWAYS.

SUPERIOR, WIS.—The purchase of the Kenosha Electric Railway Company by the Milwaukee Railway and Light Company is reported.

GRAND RAPIDS, MICH.—Russell B. Harrison, an Indianapolis capitalist, will build an electric road from Hammond to St. Joseph, Mich., with Kalamazoo as a terminal point ultimately.

NEW YORK, N. Y.—The storage battery cars on the Thirty-fourth street division of the Interurban street railway, New York city, have been discontinued and the open slot system put in operation.

SHEFFIELD, ILL.—The Kewanee Straight Line Electric Railroad has been incorporated with a capital stock of $15,000. It is stated that the company will construct a line from Kewanee to Annawan.

JACKSON, MICH.—Projectors are said to be working on an electric line between Saginaw and Flint. The route proposed is to parallel the Pere Marquette from Flint to Clio, thence to run due north to Frankenmuth, and thence to Bridgeport and Saginaw, with a short line from Saginaw and Frankenmuth to Vassar. Later the idea is to extend the line to Caro.

LA PORTE, IND.—Surveyors for the Chicago, Indiana & Michigan Electric Railway, projected to run from St. Joseph, Mich., to Hammond, where it will make a Chicago connection, have completed the survey of the route between Michigan City and Chesterton. It is stated that construction will begin in this state as soon as the line is staked out to Hammond, and that the Michigan end will also be commenced.

NASHVILLE, TENN.—Ground for the power-house of the proposed electric railway from Paducah to Cairo has been bought at Bandana, the central point on the contemplated route. The promoters of the enterprise are Paducah, Louisville and outside capitalists. The plan is to conduct a passenger and freight business, and an effort will be made to get the use of the tracks of the Paducah City Railway Company.

RICHMOND, VA.—The corporation commission has granted a charter to the Nelson & Albemarle Railway Company, which purposes to build an electric railway from the soapstone quarries, in Nelson, to the Southern Railway, in Albemarle, a distance of six or seven miles. The capital stock is placed at $250,000, and the incorporators are J. W. Foster, H. L. Lane, D. J. Carroll, F. V. Elsom, D. H. Pitts, J. G. Hopkins and George W. Bostwick.

PERSONAL MENTION.

MR. GEORGE W. JUDKINS has tendered his resignation as chief engineer of Los Angeles Traction Company, Los Angeles, Cal.

MR. H. H. GEARY, sales manager of the Fostoria Incandescent Lamp Company, of Fostoria, Ohio, stopped in New York en route from the South.

PROFESSOR CLARENCE T. JOHNSON, assistant chief of government irrigation investigations, has been appointed state engineer of Wyoming, Col.

MR. M. D. STRUT, for twelve years superintendent of the engineering laboratory of the Purdue University, has resigned that position to enjoy a well merited release from routine duties.

MR. ROBERT J. MASON, of Hampton, Va., has been appointed receiver for the Hampton Road Railway and Electric Company, and the Vandergrift Construction Company, of Newport News, Va.

MR. H. W. CONRY, for twelve years identified with the Santa Fe Railroad shops at Topeka, Kan., has been appointed superintendent of the engineering laboratory at Purdue University.

MR. J. A. ANDERSON, on September 22, will address the Modern Science Club, 125 South Elliott street, Brooklyn, N. Y., on the eastern power station of the Brooklyn Rapid Transit Company.

PROFESSOR J. MARK BALDWIN, of Princeton University, has been called to a new chair in psychology and philosophy in Johns Hopkins University. Professor Baldwin will immediately enter on his new duties.

MR. M. W. COOLEY, who is a member of the American Association of Civil Engineers, has been appointed general manager of the New Trinidad Lake Asphalt Company, Limited, of Port of Spain, British West Indies.

SENATOR GEORGE A. BARKER, vice-president of the American Conduit Company and whose headquarters are at Los Angeles, Cal., has been a visitor to New York recently on important business connected with the company's interests.

MR. WILLIAM S. BARSTOW, consulting electrical engineer, announces that he has removed his offices to 56 and 58 Pine street, New York city. Mr. Barstow will continue to give special attention to the engineering and development of electrical properties.

MR. L. S. STEWART, manager of the Postal Telegraph Company, Chattanooga, Tenn., has tendered his resignation, to accept the position of manager of the electrical department of the National Construction Company at Chicago, with headquarters at Chattanooga.

MR. WILLIAM MARCONI conferred with President Francis, Monday, September 7, at St. Louis, regarding the establishment of the wireless telegraph station on the exhibition ground. Mr. Marconi said, "I think it will be possible to send wireless messages from St. Louis to London with one relay and that at a coast station."

DR. WILLIAM A. NOYES, formerly professor of chemistry at Rose Polytechnic Institute, has tendered his resignation to accept the position of chief chemist of the Bureau of Standards at Washington, D. C. Dr. Noyes received his degree from Johns Hopkins University and has been at Rose Polytechnic Institute for several years.

MR. ROBERT T. E. LOZIER, secretary of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, and Mr. George B. Foster, manager of the Chicago office of the Bullock Electric Manufacturing Company, were New York guests registered at the Engineers' Club last week. Mr. F. G. Bolles, of this company, is expected to return about the middle of September from a European trip.

MR. RAYMOND R. FRAZOR, consular agent at Copenhagen, Denmark, under date of August 11, 1903, stated "A well-known firm with agents in Copenhagen desires correspondence with a firm in the United States which is in a position to furnish trucks for street cars and steam cars in a country foreign both to Denmark and the United States. Trucks for passenger cars will be required for the electric lines, and trucks for passenger and freight cars for the steam railways."

MR. THOMAS A. EDISON and a party of friends on September 5 made a trip from Orange to Phillipsburg, N. J., in an automobile constructed after plans drawn by the inventor. It is stated they made the run in less time than the regular passenger train. Mr. Edison is stated to have said on arriving at Phillipsburg ahead of the train which left Orange at the same time, that mile after mile his thirty-five-horse-power automobile sped over the country roads at a mile a minute. The fact that the country trip included the climb over the Schooley's mountains makes the run all the more remarkable.

PROFESSOR BYRON BRIGGS BRACKETT has been appointed to the chair of physics and electrical engineering at the Thomas H. Clarkson Memorial School of Technology, Potsdam, N. Y. Mr. Brackett received his A. B. and A. M. from Syracuse University, and his certificate in electrical engineering and Ph. D. from Johns Hopkins University. He is an associate member of the American Institute of Electrical Engineers and a member of the American Association for the Advancement of Science. As instructor, he has been associated with Dickinson Seminary, Williamsport, Pa.; Adelhpi Academy, Brooklyn, N. Y.; Eastern High School, Washington, D. C.; electrical engineering laboratory, Johns Hopkins University, Baltimore, Md.; Union College, Schenectady, N. Y., and Rutgers College, New Brunswick, N. J., with which institution he was last connected previous to his appointment with the Clarkson School of Technology. His practical electrical engineering experience comprises the testing and inspection of all the cable manufactured for the United States Army during the Spanish-American War by the General Electric Company, Schenectady, N. Y.; a year's work with the late Professor Henry A. Rowland, of the chair of physics, Johns Hopkins University, and in the development of the Rowland printing telegraph, with considerable experience in commercial electrical testing at various times.

INDUSTRIAL ITEMS.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, on September 12 gave its annual picnic to its employés, at Silver Lake, Ohio. The amusements included races, baseball, dancing, bowling and boating.

DUNCAN ELECTRIC MANUFACTURING COMPANY, La Fayette, Ind., has published a new edition of its pamphlet descriptive of the Duncan integrating wattmeter for direct-current lighting and power service.

CINCINNATI ELECTRIC MOTOR COMPANY, Cincinnati, Ohio, announces that its name has been changed to the Barriett Electric Company; Mr. S. L. Barriett, president. It will expend about $50,000 for improvements.

CROCKER-WHEELER COMPANY, Ampere, N. J., has recently brought out a pamphlet which gives an instructive description of the equipment of the new locomotive and car shops of the Lake Shore & Michigan Southern Railway at Collinwood, Ohio.

THE EMPIRE ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has just been incorporated with a capital stock of $10,000. This company will manufacture and deal in electrical devices. The incorporators are C. W. Farr, A. N. Barothy and C. L. Hibbard.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, has brought out an attractive circular, wherein is given data from the results of which is made the assertion, that "phenomenal" is the word which expresses the remarkable increase in the use of Columbia carbons in the past few years.

H. T. PAISTE COMPANY, Philadelphia, Pa., has about completed the general distribution of its new catalogue No. 10, which it considers practically "a dictionary of electrical supplies." There is listed besides a line of general supplies, the most recent specialties taken up. Copies of this catalogue will be sent on request.

THE SPEER CARBON COMPANY, St. Marys, Pa., has brought out an attractive circular descriptive of the Speer high-grade motor brushes. This brush, the manufacturer claims, is of uniform texture and offers a soft frictional surface. The company guarantees that the brush will not heat up under the most severe circumstances.

I. B. WILLIAMS & SONS, Dover, N. H., tanners and manufacturers of oak-tanned leather belting, rawhide and tanned lace leather, have distributed a souvenir in the form of an illustrated booklet giving the history of the international cup races and illustrations of the more prominent boats which have participated in these contests.

WESTERN ELECTRIC AND MANUFACTURING COMPANY, New York city, announces the removal of its New York sale department, Department I, the export and the general agent's office to the New Hanover Bank Building, 11 Pine street. The executive, financial and stock transfer offices will remain on the fourth floor of the Equitable Building, where they have been located since 1889.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, has published a novel booklet which is entitled "Things About Inner Arc Globes." This gives in detail the conditions under which arc lamp globes operate and the elements of difficulty with which this service is beset. A supplement to this matter is a chapter on "A Few Points That the Trimmer Should Not Forget," and a chapter on cleaning.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, Ill., has just brought out its general supply catalogue No. 20. This catalogue is a very attractive one in appearance, completeness and arrangement and is fully up to the standard of catalogues. It lists many new articles that have, it is stated, never been shown in a supply catalogue, and all out-of-date items have been eliminated. The company will send this catalogue out on request.

WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has recently brought out a new portable ammeter, which can be furnished with a series transformer having leads thirty feet long, and so arranged that the series transformer can be slipped over the lighting transformer leads without disturbing them in any way. A card, descriptive of this instrument and also of a polyphase wattmeter, portable or switchboard, is also being distributed.

THE INTERNATIONAL STEAM CONDENSING COMPANY, Atlanta, Ga., manufacturer of cooling towers and condensers, will be pleased to answer correspondence with regard to the equipment of engine plants for cooling towers. An elaborate series of tests made of a cooling tower at the Federal Prison, Atlanta, Ga., shows the results which have been obtained by this company's installation. This datum is valuable and the company will be pleased to mail it to any one interested.

THE VOUGHT-BERGER COMPANY, La Crosse, Wis., manufacturer of telephone switchboards and appliances, has recently placed on the market a new magneto telephone designated as No. 45. This telephone is equipped with standard Vought-Berger Bell type, solid-back, long-distance transmitter, mounted on a hollow adjustable arm with double concealed cord, bipolar receiver with concealed cord connections, silk-wound long-distance induction coil, long-lever switch hook equipped with three or four-bar series generator, or four or five-bar bridging generator; all binding-posts concealed.

THE STOW MANUFACTURING COMPANY, Binghamton, N. Y., in bulletin No. 52 describes the operation and application of Stow multi-speed motors. The speed control of this motor is a departure from that which has generally been adopted, and does away entirely with any outside apparatus, the speed control being entirely self-contained. The special advantage which the company claims for its multi-speed motor is that it requires but one voltage to operate on any speed. There is a total absence of auxiliary machines, wiring and apparatus, and at all speeds the machine operates at its full rated horse-power capacity. The speed is steady under load changes, and a high efficiency is obtained through the entire speed range. The characteristics of this motor make it specially adapted for driving individual machine tools, lathes, planers, milling machines, slotters, drills, presses, roll lathes, boring mills, printing-presses, power pumps, blowers, compressors, fans, etc.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., will be pleased to send to any one interested, upon request, a valuable booklet which has recently been published, on "Water Purification for Cities by Sulphate of Iron." This gives the details of water purification by mechanical and chemical treatment with sulphate of iron, for domestic and commercial use, and contains reports by Earnest E. Irons, bacteriologist, and James E. Campbell, chemical engineer. Sulphate of iron is one of the chemical products of the American Steel and Wire Company. To demonstrate its particular use in the purification of water, exhaustive tests have been made under the supervision of Messrs. Irons and Campbell. The waterworks system at Quincy, Ill., was selected as the plant at which to make the tests, because of the exacting conditions prevailing there, which would make favorable results all the more valuable. It was desired by the American Steel and Wire Company that the most scientific research and experiment be conducted, and nothing was omitted that would contribute to this end. The result is most favorable to the employment of sulphate of iron for the purification of water for both domestic and commercial uses. The report will be found to contain a great deal of valuable information, and should be given careful consideration by any one interested in this line of study.

THE STANDARD POLE AND TIE COMPANY, Venezuela Building, 133 Front street, New York, is introducing a cypress pole, as it introduced the juniper pole some four or five years ago. For the last half century the juniper or southern white cedar has been used in the South extensively, but the Standard Pole and Tie Company has made it a point to advertise it and thoroughly introduce it in the North. This company recognized the superior quality of the juniper and decided to push it, with a result that it has become known throughout all the states as a standard of quality among poles. The company's best customers are the street railway companies, to whom it has sold over 100,000 in the last two years. The telephone companies and electric light companies alone, however, send enough orders to keep any small concern busy. For some time the company has been experimenting with the cypress. This like juniper, is a southern swamp growth. Both are free from butt rot, have exceedingly close grain and a remarkably small percentage of sap wood. The cypress, however, is naturally very heavy; so heavy in fact, that the company thought it impossible to use it as a pole on account of the freight. By careful tests it has been found that by girdling the tree some three weeks before it is cut, and then keeping it entirely out of the water until it has seasoned for sixty days, the weight is decreased nearly one-third. This renders the pole marketable. It is the intention of the Standard Pole and Tie Company to push the cypress pole as it has pushed the juniper and it no doubt will meet with equal success.